Heating Piping & Air Conditioning

APRIL 1955

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INDUSTRIAL • COMMERCIAL • INSTITUTIONAL • PUBLIC BUILDINGS

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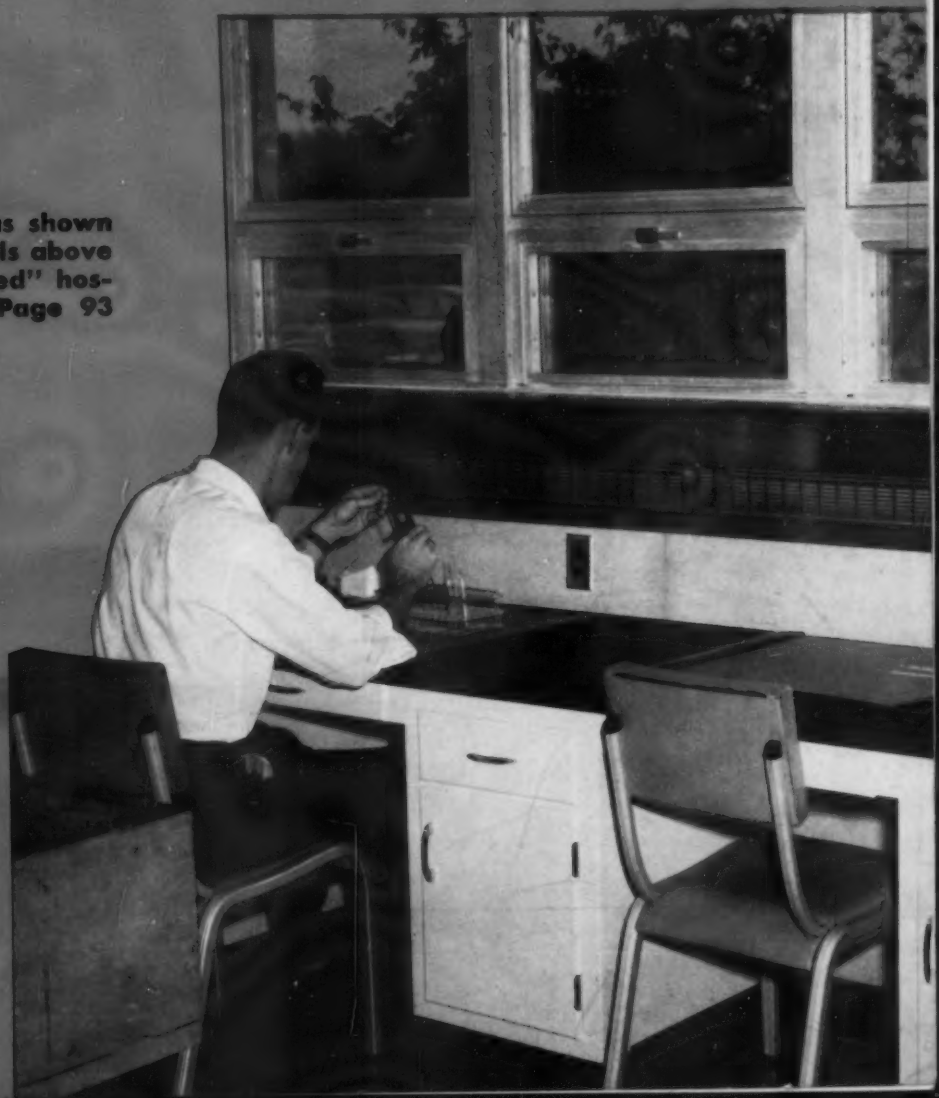

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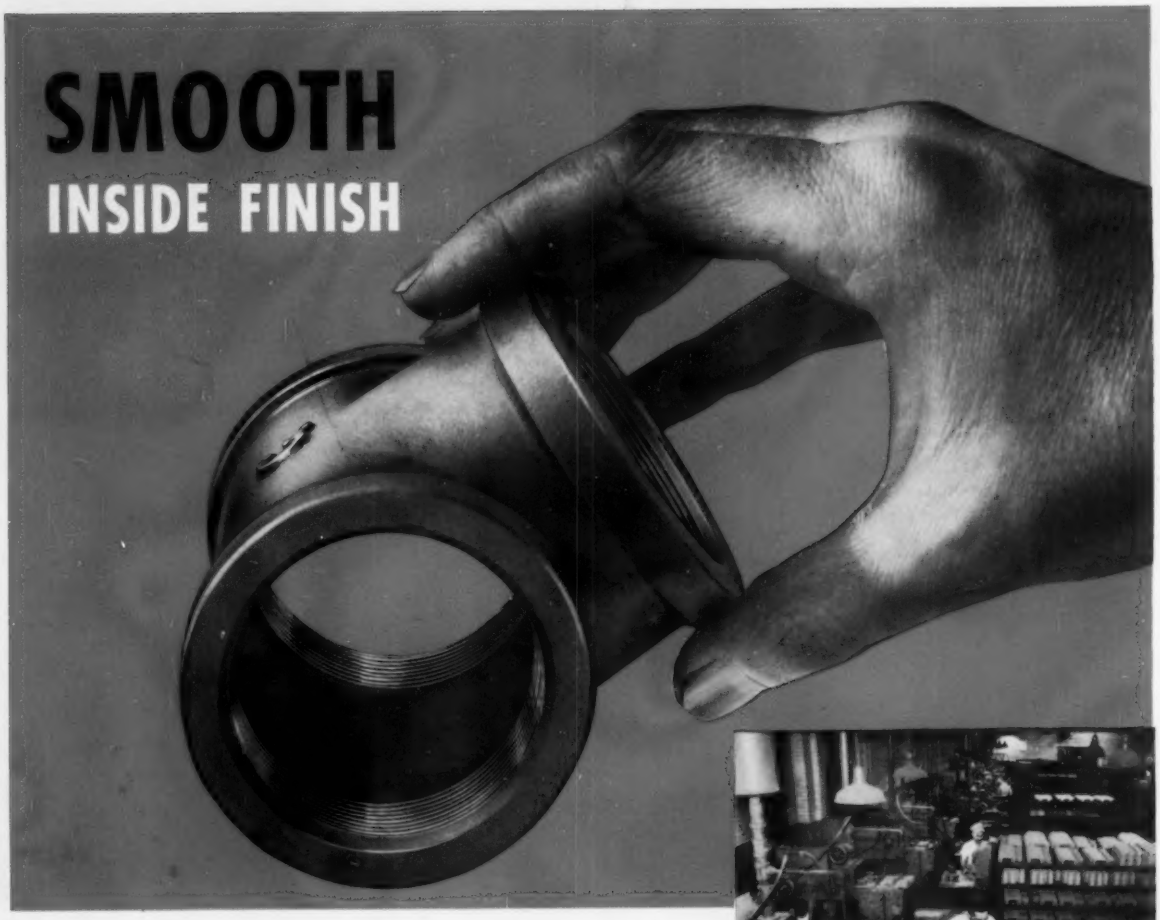


Grinnell cores combine the finest materials with expert workmanship.

Modern production methods, finest workmanship...

Typical of Grinnell rigid standards of manufacture is the use of the finest materials in the making of cores. The result is smooth inside surfaces for free flow in piping installations.

High manufacturing standards — plus high quality metal, modern equipment, latest production techniques, and quality control of every step of manufacture, make the complete line of Grinnell Pipe Fittings uniformly reliable.

Whenever you specify Grinnell Cast Iron and Malleable Iron Fittings, you can be sure of —

- **uniform wall thickness**
- **high quality metal, free from sand holes and wall leaks**
- **tested strength**
- **precision threads for easy running up and tight joints**
- **proper chamfer for easy starting and protection of first thread**
- **smooth cores; dimensional accuracy**

Remember, the Grinnell "G" trade-mark is your assurance of the finest in fittings.

AVAILABLE FROM YOUR LOCAL DISTRIBUTOR.

GRINNELL
PIPE FITTINGS

Grinnell Company, Inc., Providence, Rhode Island

Manufacturer of: pipe fittings • welding fittings • forged steel flanges • steel nipples • engineered pipe hangers and supports Thermolier unit heaters • Grinnell-Saunders diaphragm valves • prefabricated piping • Grinnell automatic fire protection systems

new "all-season"

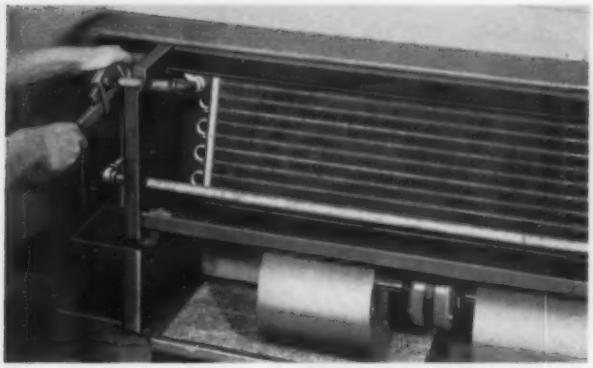
usAIRco modu-aire

most advanced unit on the market!

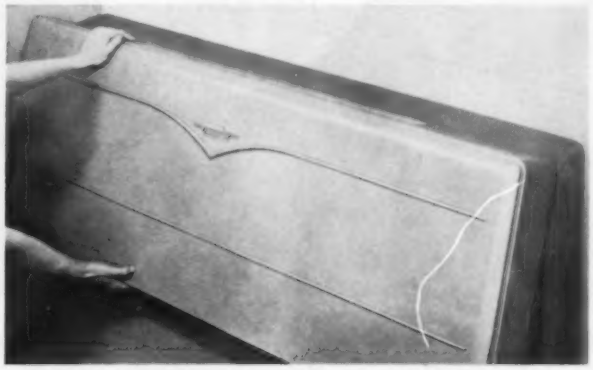
Every wanted feature is built into usAIRco's new, completely redesigned Modu-aire unit, making it the ultimate in individual room controlled, year 'round air conditioning systems.

Compact in size, Modu-aire is adaptable, without alteration for semi-recessed or free-standing installation. Ceiling hide-away or basic floor models available for fully recessed applications. Modu-aire is ideal for multi-room structures, needs no duct-work since small copper tubing carries both hot and cold water to the unit.

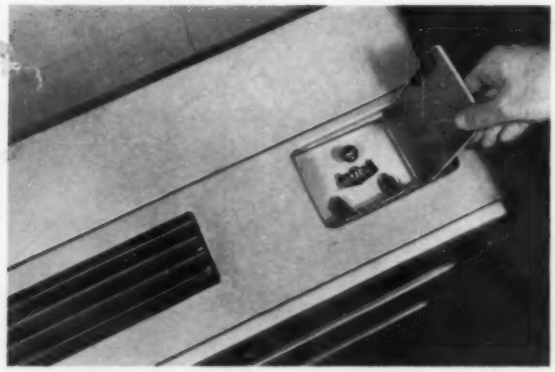
Its trim, unobtrusive design makes it live harmoniously with the finest decor in new or existing motels, hotels, schools, banks, offices and other buildings. Available in 200, 400 and 600 cfm capacities to suit your requirements.



SIMPLE TO INSTALL . . . JUST A MATTER OF MINUTES. Adequate space in cabinet across face of coil permits water piping to enter from either side through knock-out holes on both vertical interior side panels. Auxiliary condensate drip pan is easily moved to whichever side is used for piping hook-up. Cabinet and drain pan are thoroughly insulated to prevent condensation and insure quiet operation.



ONE PIECE COVER SLIPS ON EASILY—can be handled by one man. Two thumb screws on bottom secure panel in place, after it hooks over the top. Simple to remove for servicing.



EASILY ACCESSIBLE CONTROL PANEL is available with a choice of the following: (1) Push-pull fresh air damper control. (2) 2-speed fan control. (3) Thermostat for cooling and heating. The adjustable airfoil louvers are designed to prevent condensation from aspiration on the sides of outlets.

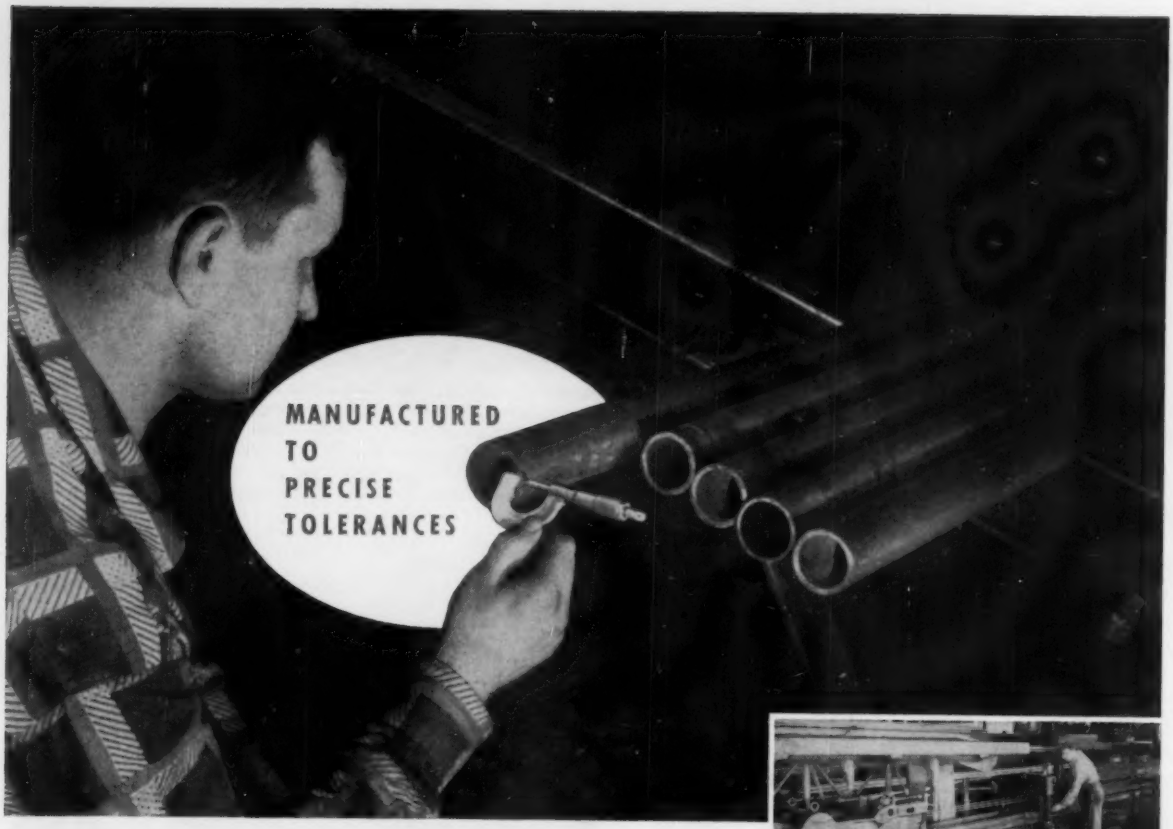
SMARTLY DESIGNED CABINET IS DIE-FORMED. Bolster strips in front design give it sturdy, self-supporting rigidity . . . you can even sit on it! Permanent, cleanable filter slides in and out without removing front panel. Recessed toe-space contributes to the clean lines of the unit and avoids damage from foot traffic.

For further details write R. S. McLain

UNITED STATES AIR CONDITIONING CORPORATION

MINNEAPOLIS 14, MINNESOTA *Export 13 E. 40th Street, New York 16, N. Y., U. S. A.*

usAIRco
30 YEARS OF AIR CONDITIONING



For heat exchangers and condensers . . .

COLD DRAWN WROUGHT IRON TUBING

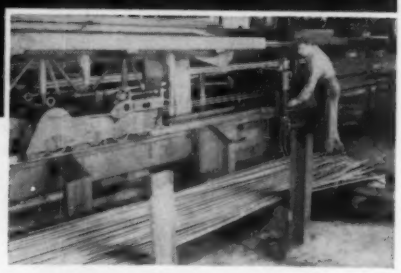
Here's your answer to *extra life* in tubing services. Cold drawn wrought iron tubing—because its composition and structure are the same as wrought iron pipe—provides the same time-proved protection against corrosion and fatigue failure. This longer service life advantage, combined with precise tolerances, make cold drawn tubing ideal for:

- **ammonia condensers**
- **heat exchangers**
- **pre-heaters**
- **gas cooling apparatus**
- **gasoline condensers**
- **evaporators**
- **cooling pipe and steam condensers**
- **salt and brine lines in air conditioning services**

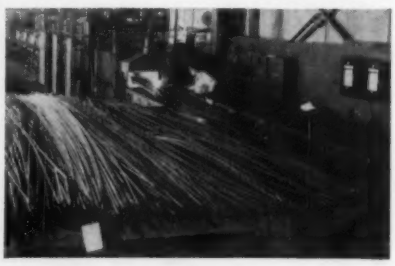
The ability of cold drawn wrought iron tubing to reduce the frequency of repair or replacement in these and similar services is amply supported by actual service records.

You'll find it profitable to investigate cold drawn wrought iron tubing for your particular installation. We will be happy to discuss your needs. Just write or call.

A. M. Byers Company, Pittsburgh, Pa. Established in 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Department: New York, N.Y. *Available throughout the world.*



"Drawing" process—mandrel controls inside diameter and die reduces outside diameter as tubing is drawn. Interior and exterior of tubing are smoothed in process.



Annealing process restores ductility of the tubing. Ring gauge is then used to check OD, followed by a micrometer reading for wall thickness.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY STEEL PRODUCTS

Heating Piping & Air Conditioning

Vol. 27 No. 4

(with which is merged the Aerologist)

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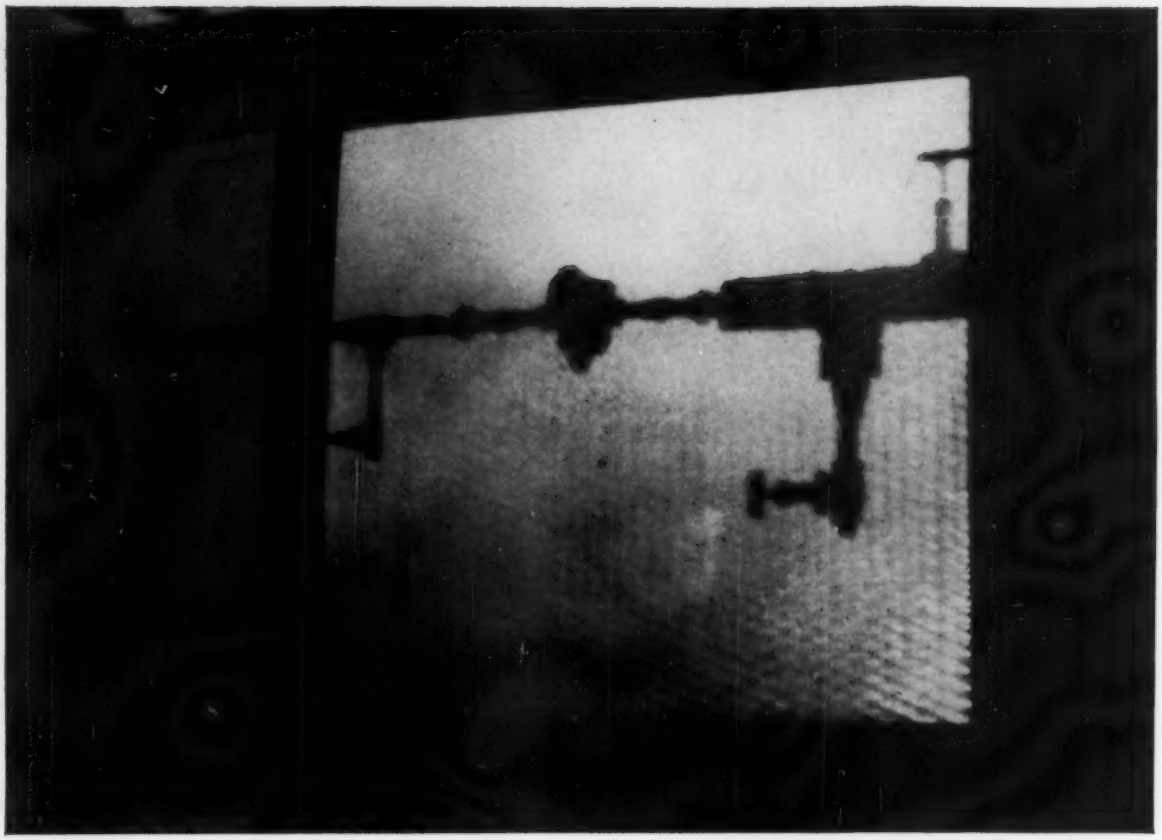
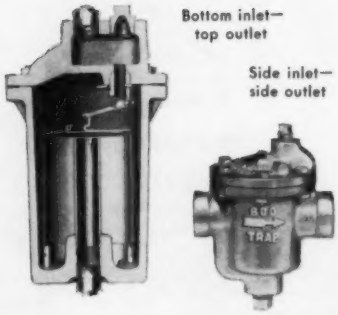


A Steam Trap Casts a Mighty Big Shadow



Corrosion- and wear-resistant materials; "frictionless" leverage; precision workmanship — add up to LOW MAINTENANCE.

Here are some of the results of retrapping equipment with Armstrongs:

Higher Temperatures. Milk dryer temperatures maintained 100° higher at Rochester Dairy Co., Rochester, Minn.

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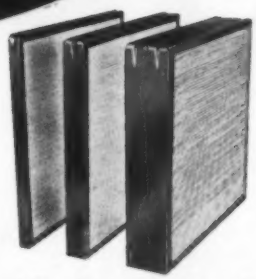
Application Engineered
ARMSTRONG STEAM TRAPS

ASK FOR CATALOG . . .
The 44-page Steam Trap Book gives more examples of how good trapping helps users, tells how to get it . . . selection, installation, maintenance. Free on request — write or call today.

Armstrong traps also cataloged in Sweets and Chemical Engineering Catalog. 555

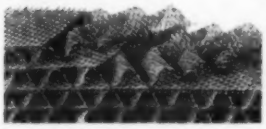
THE MEASURE OF A GOOD AIR FILTER

1", 2" or 4" thick?



Whether you need filters for package air conditioners or furnaces, for general filtration or for special applications requiring the highest efficiency and greatest dirt capacity, Farr Company has a standard type to fit the job—available in steel, aluminum, copper, stainless and monel.

How much media?



In FAR-AIR* filters you get more media per square inch *plus* the famous herringbone-crimp design that assures greater dirt holding capacity and lower pressure loss. Firmly packed media provides even density and assures uniform high efficiency over the entire filter area.

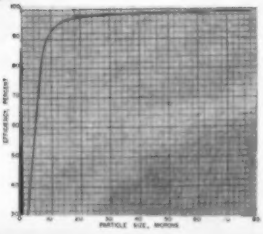
FARR COMPANY
NO COMPROMISE ON QUALITY
Los Angeles, New York, Chicago, Memphis

*Trade Mark

What kind of construction?

Heavy gauge filter frames and interlocking holding frames assure rigid filter banks and proper fit. Reinforcing rods drilled through the filter media make the filter more rugged. *Engineered* quality assures longer service life.

How efficient?



High efficiency in a filter is its only real reason for existence. FAR-AIR* filters consistently deliver superior performance. Send for your set of efficiency curves which show how the various types of FAR-AIR* filters will perform for you.

FARR COMPANY
P. O. Box 45187, Airport Station
Los Angeles 45, California

☐ Send efficiency curves
☐ Send a Farr Field Engineer

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Company_____

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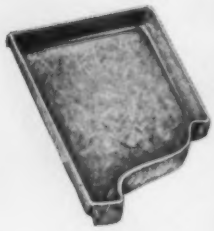

A CHALLENGE!

THE STRONGEST MADE BY ANY GALVANIZED SHEET:

Anything that

If you've been having difficulty fabricating galvanized sheets, try Wheeling sofTite Galvanized Sheets.

Here are sheets you can work to the limits of the base metal . . . so ductile, so tight-coated, you can use them for anything you make of steel sheets.

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Put sofTite to the test. See for yourself why the demand for sofTite has forced Wheeling to triple its production facilities in 1955.

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Send for full information today. Call or write the Wheeling sales office nearest you.

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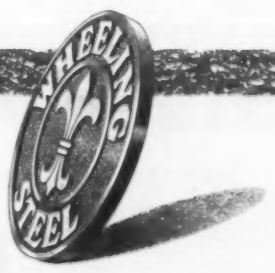

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Modern bank shows how you can provide

Ideal indoor weather for the most modern kind of building

Why Honeywell Customized Temperature Control is a "must" in modern buildings

THE need for a truly modern control system is well illustrated by the New York City Fifth Ave. branch bank of the Manufacturers Trust Company.

The building was designed with drama in mind, is open and inviting to the public—and is a highly efficient work place for the bank's staff.

Important in making a building attractive and efficient today is ideal Indoor Weather—the kind furnished by Honeywell Customized Temperature Control in the Manufacturers Trust Company's Fifth Ave. branch and in many other buildings across the country.

Strategically placed Honeywell thermostats (see floor plan) compensate for every possible occupancy, exposure and use comfort factor, making this new branch bank one of the world's most comfortable places to work and to do business in.

The *techniques* used in solving these comfort problems can help you provide the Indoor Weather required for your clients' facilities—for a Honeywell Customized Temperature Control installation is *designed to fit the needs of the building and its occupants.* This applies not only to heating and cooling, ventilating and humidity control, but to industrial control as well.

Only Honeywell can provide true "customized" control. Because only Honeywell manufactures all three types of controls—electronic, pneumatic and electric.

A separate thermostat system was installed in the conference room above to provide comfort no matter what the weather—or size of the gathering. The sensitive Honeywell thermostat calls for just the right amount of heating, cooling or ventilating—according to the season and size of the meeting. Thus Honeywell Customized Temperature Control meets the varying needs, compensating for occupancy as well as the season.

Strategically located thermostats in large banking areas such as the one shown provide comfort at all times. They do this by compensating for exposure, occupancy—and for varying crowds at different times of the day. In addition, comfort is maintained in private offices (see floor plan) by installation of a thermostat in each office. This meets the needs of individual offices—and of the individuals who occupy them.

Large glass areas create an inviting open look. But they also admit a great amount of solar heat, and transmit winter chill. This calls for Honeywell Customized Temperature Control—if comfort is to be assured.

TOP FLOOR PLAN

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For comfortable, more productive temperature in new or existing buildings—of any size—specify Honeywell Customized Temperature Control

Whether it's a bank, church, school, office, motel, hospital, factory—any building of any size—new or existing, Honeywell Customized Temperature Control can help meet your clients' heating, ventilating, air conditioning and industrial control problems.

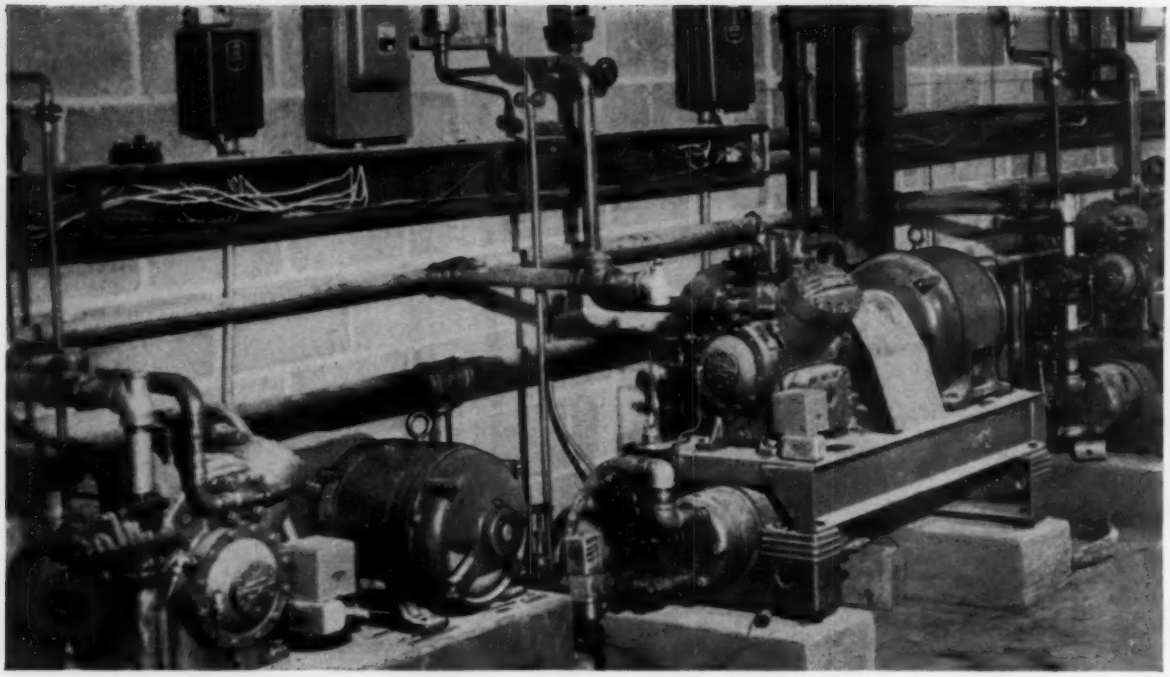
You can give your clients more comfort and efficiency, and they'll save fuel, too.

For full facts on Honeywell Customized Temperature Control, and the economical Honeywell Periodic Maintenance Plan, call your local Honeywell office. Or write Honeywell, Dept. HA-4-56, Minneapolis 8, Minnesota.

MINNEAPOLIS
Honeywell

Customized Temperature Control

H HONEYWELL *112 offices across the nation*

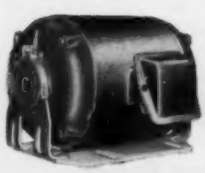


Let each job select

Century **MOTORS ARE Performance-Rated®**

Why settle for *less* motor than you need? Or why pay for *more* motor than you can use? The most efficient and economical motor is one that is fitted to its application . . . A Performance-Rated Century Motor.

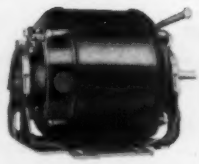
Performance-Rating means simply that from



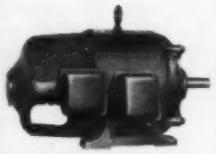
Squirrel Cage, Polyphase Motors . . . ¼ to 400 H.P. . . . available in drip proof and dust proof frames, with sleeve or ball bearings, foot or flange mounting (cushion base available through 5 H.P.).

Repulsion Start, Induction Motors . . . single phase . . . ½ to 7½ H.P. . . . provide high starting torque on applications requiring unusually low starting current.

Capacitor Motors . . . ½ to 20 H.P. . . . available in drip proof and dust proof frames, with sleeve or ball bearings, foot or flange mounting (cushion base available through 5 H.P.).



Split Phase, Unit Heater Motors . . . 1/20 to ½ H.P. . . . available with extended-through bolts or cushion base . . . split capacitor, DC and polyphase types also available.



Slip Ring Motors . . . 1 to 400 H.P. . . . a favorite for applications requiring unusually low starting current. Available in drip proof, splash proof and dust proof frames.

for example: **This large Midwestern warehouse refrigeration installation is powered by seven Performance-Rated Century Motors, ranging in size from 3 to 10 H.P.**

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for compressors, oil burners, blowers, heaters, pumps, fans and scores of other appliances. Century will provide you with a handsome display stand, plus an easy-to-sell assortment of motors that will put you into the profitable replacement motor business. Mail this coupon for information today!

Performance-Rated® Motors

1/8 to 400 H. P.

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City..... Zone..... State.....

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Here are 2 584 125 Firebox Steam Boilers for gas or oil

Architect—F. O. Wolfenbarger & Associates, Manhattan, Kans.; Engineers—Howarth, Scott & Kinney, Kansas City, Mo.; Heating Contractor—Woodhull Plumbing Co., Manhattan, Kans.

KEWANEE

reserve plus rated boilers . . .

GUARANTEE EXTRA POWER TO MEET EMERGENCIES

When you think of protecting life in hospitals, you probably first think of spotless operating areas, sanitary rooms, fresh clean linen on gleaming white beds. And they're all important, too. But such safeguards would be for naught if power failed in the boiler room when emergency called. So, Architect F. O. Wolfenbarger and Engineers Howarth, Scott & Kinney made sure in planning for the Riley County Hospital, Manhattan, Kansas. Kewanee Reserve Plus Boilers were selected because they are certified to deliver 50% extra power, that measure of protection always "on call" no matter what the need. So, don't be misled by promises that a boiler delivers enough steam to meet average daily requirements. Be sure there is extra reserve to take care of unusual conditions. For that is when performance beyond the call of usual duty is a necessity. Kewanee Reserve Plus Rated Boilers guarantee that protection.

KEWANEE BOILERS

KEWANEE-ROSS CORPORATION, Kewanee, Illinois

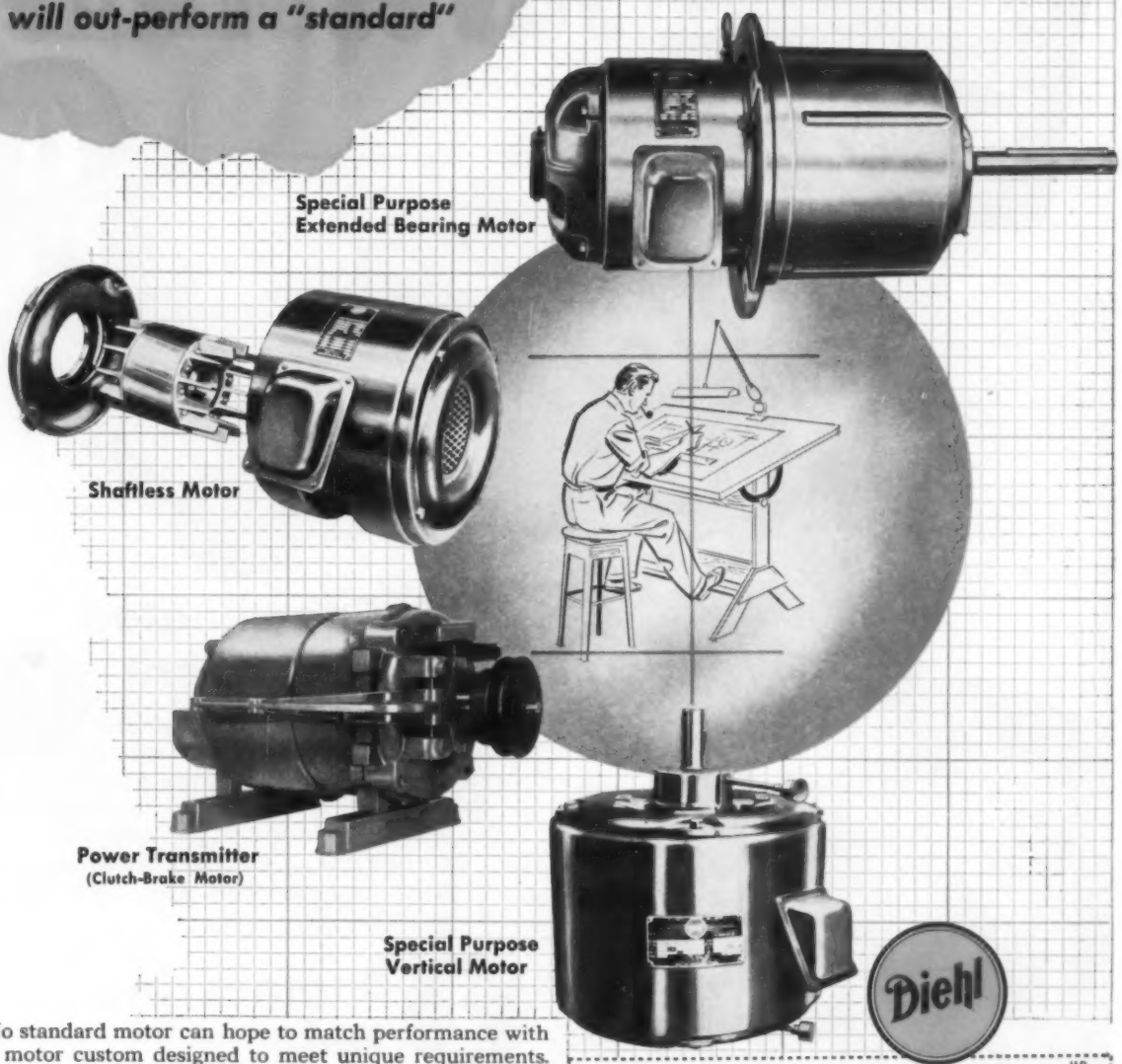
Division of American Radiator & Standard Sanitary Corporation

Serving home and industry: American-Standard · American Blower · Church Seats & Wall Tile · Detroit Controls · Kewanee Boilers · Ross Exchangers · Sunbeam Air Conditioners

YOU can depend on KEWANEE engineering

a motor designed for its job

will out-perform a "standard"



No standard motor can hope to match performance with a motor custom designed to meet unique requirements.

That's why Diehl lays so much emphasis on custom construction . . . why, through the years, it has geared its abilities and its facilities, its design, engineering and manufacturing functions for maximum cooperation with its customers . . . whatever the application.

DIEHL custom-tailored motors can:

Cut costs • Save space • Reduce weight • Improve safety
Simplify design • Speed production • Improve appearance

When you want a fast, thorough answer to an unusual motor problem it will pay you to consult Diehl. Name your conditions . . . Diehl will design and build to match.

HP

DIEHL MANUFACTURING COMPANY
Electrical Division of THE SINGER MANUFACTURING COMPANY
Finderne Plant, SOMERVILLE, N. J.

Please send me the following bulletins:
☐ New Type "D" Motor Bulletin No. TW-3304
☐ Consolidated Catalog & Price TW-3310

Name_____
Company_____
Street_____
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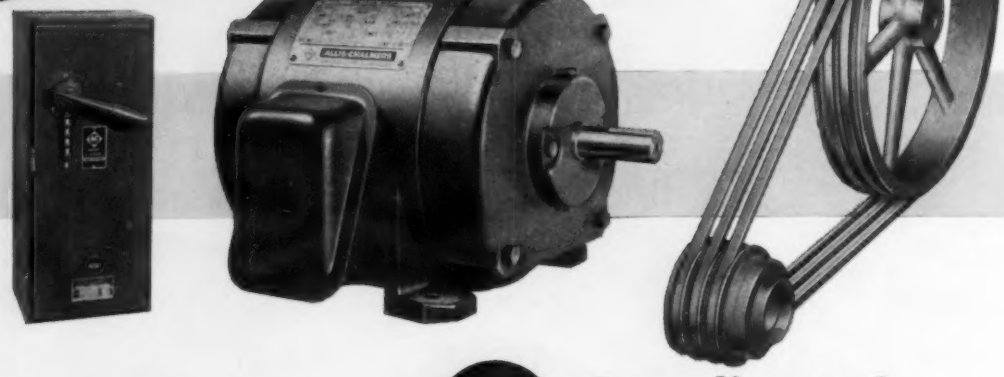
INTEGRAL AND FRACTIONAL HORSEPOWER MOTORS ARE AVAILABLE IN A WIDE RANGE OF TYPES AND SIZES

This 3-Way Saves Time.

ALLIS-CHALMERS
EQUIPMENT FOR
Air Conditioning



1 Coordinated Equipment

End the worry of coordinating three sources of supply. With Allis-Chalmers control-motor-drive combination, one reliable supplier guarantees the complete drive. All components are shipped from one supplier, arrive ready to be installed.

For one source . . . one responsibility, get Allis-Chalmers complete service, from power line to driven shaft.

2 Engineering Help

An experienced Allis-Chalmers distributor or district representative is ready to help you engineer the complete drive. This can make the job easier and more profitable for you. Components are designed to work together. One specification, one set of calculations — one order brings you the complete drive.

ALLIS-

Drive Combination ..Money...Trouble!

3

Near you there's an adequate stock of drive components commonly used in air conditioning installations. Stocks are maintained by Allis-Chalmers Authorized Distributors and Regional Offices. In addition, an efficient warehouse inventory system locates hard-to-get items within hours after you call.

There's an A-C Certified Service Shop near you, too. There are nearly one hundred independent service shops which meet strict Allis-Chalmers standards for modern equipment, efficient methods and business integrity. These shops use factory-approved parts and methods.

Texrope is an Allis-Chalmers trademark.

A-4624

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CONTROL

- ☐ Handy Guide to Starters 14B7733
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***TEXROPE* DRIVES**

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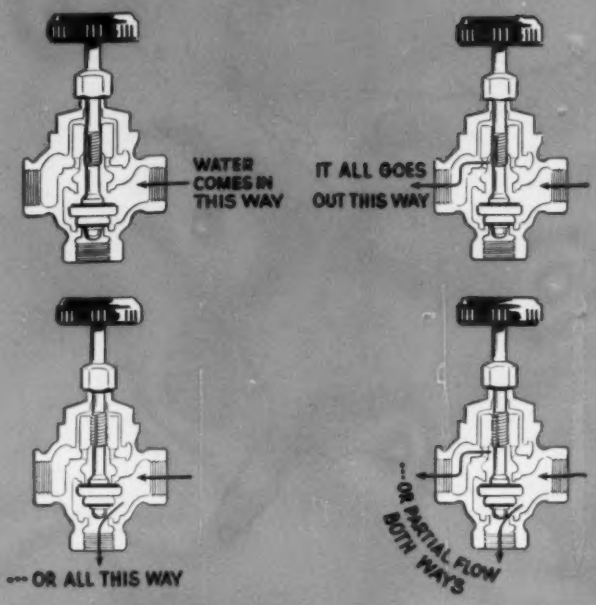
A-C ALLIS-CHALMERS

CHALMERS

O-B Three-Way Valve Works Like This



● Here's a low-cost valve that can be installed on any forced circulation heating or cooling system using remote units. Water flow through the unit can be controlled manually in any of the three ways shown above.

Regardless of the position of the valve, the quantity of water pumped through the system does not change. That means each unit can be adjusted to suit individual preference of temperature range without affecting other units in the system. It means the pump load remains constant, providing protection against pump damage.

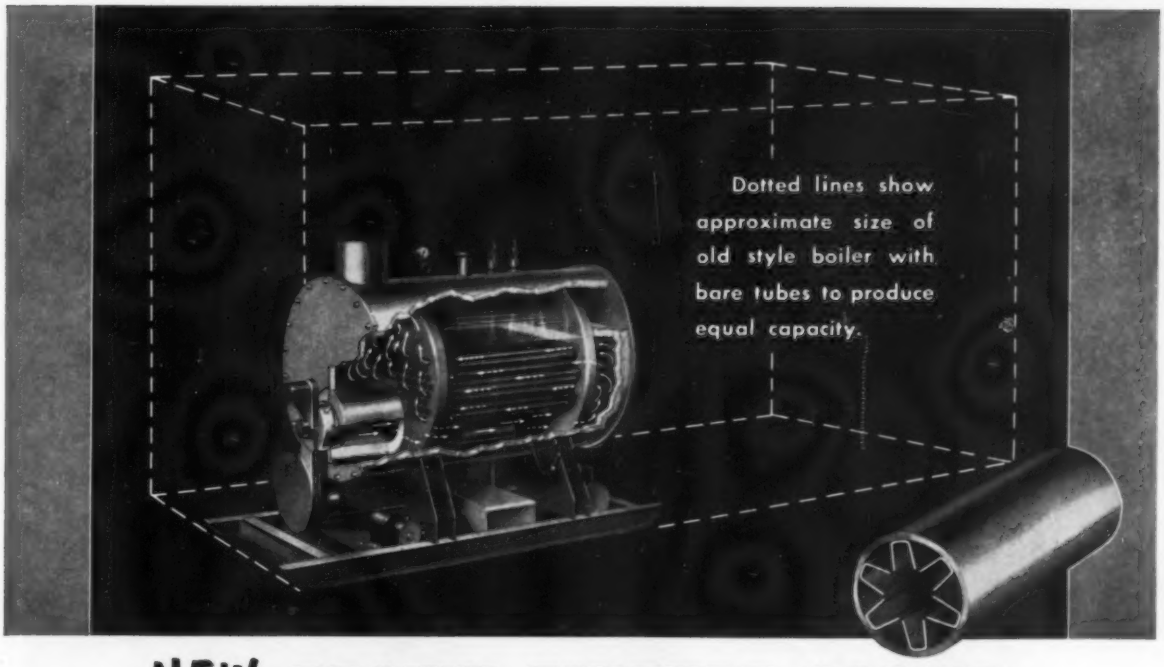
The No. 4600 valve is available with threaded pipe ends in ⅜ or ½-inch sizes. Pipe ends can also be supplied bored to accommodate ½-inch tubing.

Additional information on this new valve is contained in bulletin 1319-V. Write for your free copy.

Ohio Brass

MANSFIELD B OHIO, U.S.A.

4871-V



NEW BROWN FINTUBE BOILER

uses *Internally Finned* boiler tubes

to produce more steam from much less space

A Brown Fintube Boiler—size for size—is about ⅔ as wide, ½ as long and ⅔ as high as a conventional bare tube boiler of equal capacity.

Of new design throughout, this boiler reflects the company's more than 17 years of outstandingly successful experience applying the advantages of extended surface finned tubes to the chemical and petroleum industries. Now — for the first time — the same proven advantages of extended surface finned tubes have been applied to boilers, where the use of finned tubing offers so many advantages.

Our internally finned tubes have 3 times more fire-side surface than plain bare tubes, to pick up heat and transfer it to the water; create greater turbulence; and bring the hot gases in more intimate contact with the heat transfer surface. Consequently, we extract the maximum amount of heat, consistent with good combustion practice, in just *one pass* through a *short tube* — thus eliminating the need for big, heavy assemblies, and reducing the forced draft and stack requirements.

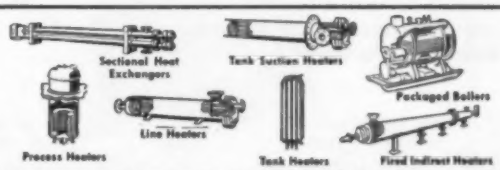
Before you buy anything else be sure to investigate fully the newest, most modern, and most efficient boiler on the market today. Write now for a copy of Bulletin No. 542. It gives full details, tells why finned tubes transfer heat better than just plain bare tubes. *Write* for your copy of Bulletin No. 542 *today.*

SEVERAL DESIRABLE TERRITORIES STILL AVAILABLE

HEAT EXCHANGE SURFACE
BROWN FINTUBE
HEAT TRANSFER PRODUCTS

BROWN FINTUBE CO.

345 HURON ST., *Elyria, Ohio*



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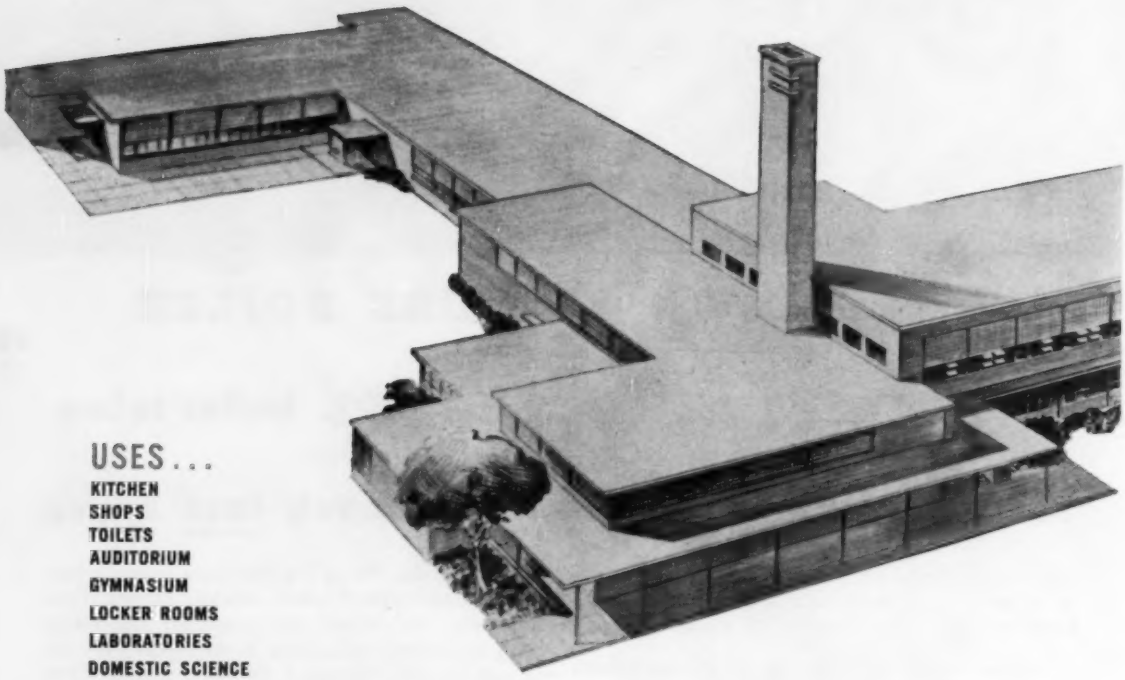
Bid school ventilating jobs close



USES . . .

KITCHEN
SHOPS
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If competition is close and the price must be right, why take chances? You can be sure of yourself when you engineer a job and specify Peerless Fans and Blowers. Here's why. Peerless ratings are right. This high-rated 58-year-old corporation guarantees them. The Peerless line is complete, too, and there's no need for you to "oversize" a job to play safe on capacity. We know, and you know you are right with Peerless, because EVERY fan and EVERY blower is tested before you get it . . . there's no spot checking on Peerless assembly lines . . . **every unit is tested.**

Peerless air handling equipment is in use everywhere. On whatever job you are contemplating, Peerless can help with its experience in parallel cases. Peerless' complete engineering, testing, and research staffs are at your command. Engineers, architects and builders by the score will testify to Peerless' ability to meet your most rigid requirements. They have seen Peerless do it.

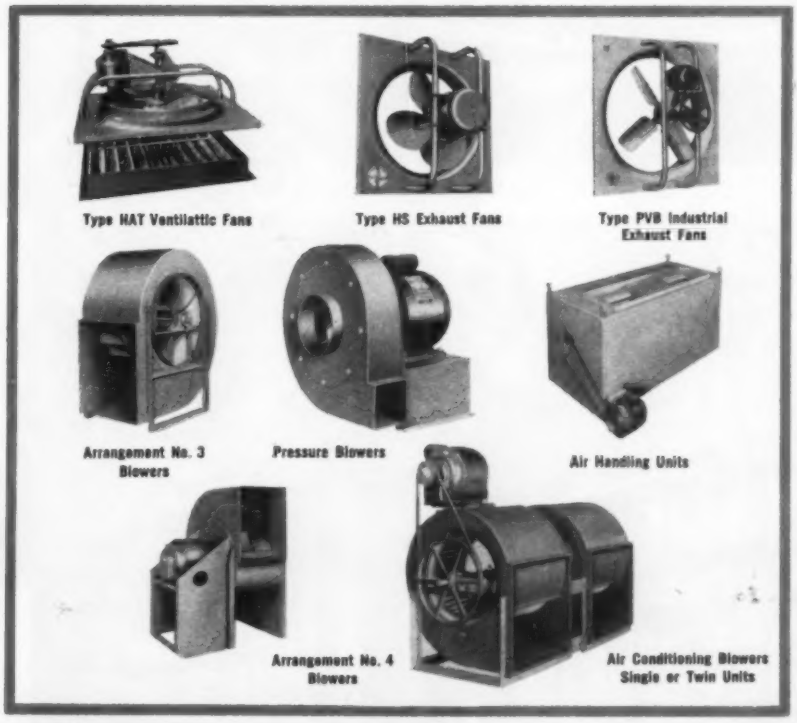
So, whether it be a school, hospital, office building or apartment, give Peerless the nod. Send for catalog or any specific data you may need. You'll be glad you did.

FANS BLOWERS

THE PEERLESS ELECTRIC COMPANY

with Peerless Fan and Blower

Guaranteed Ratings


Type HAT Ventilattic Fans
Type HS Exhaust Fans
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Arrangement No. 3 Blowers
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Air Handling Units
Arrangement No. 4 Blowers
Air Conditioning Blowers Single or Twin Units

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MOTORS

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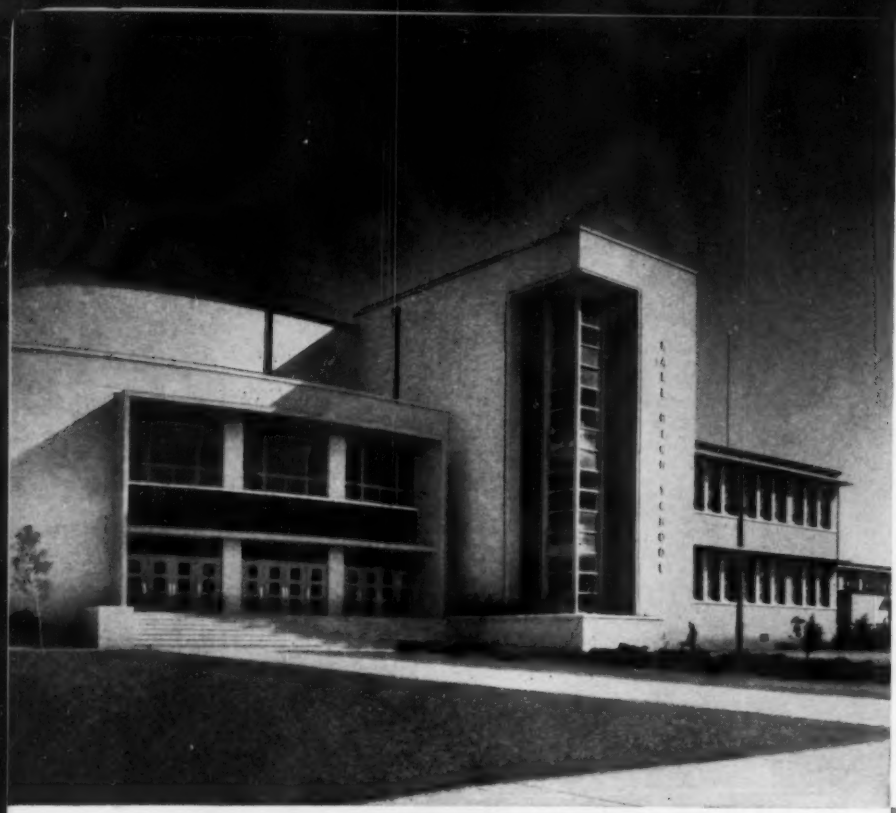


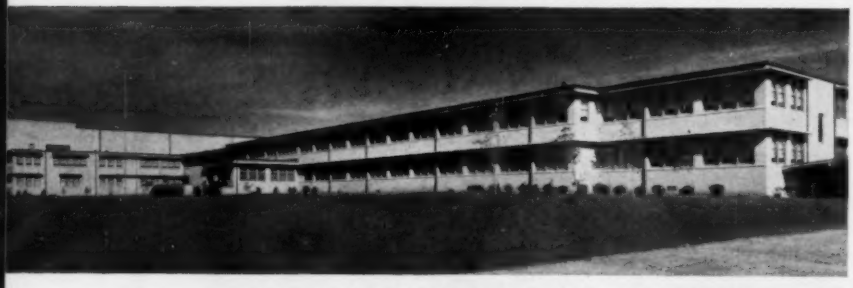
BALL HIGH SCHOOL, GALVESTON, TEXAS • See Rear View Below

Architects for both buildings
PRESTON M. GEREN,
Fort Worth, Texas
R. R. RAPP,
Galveston, Texas

Mechanical Engineers
YANDELL, COWAN & LOVE
Fort Worth, Texas

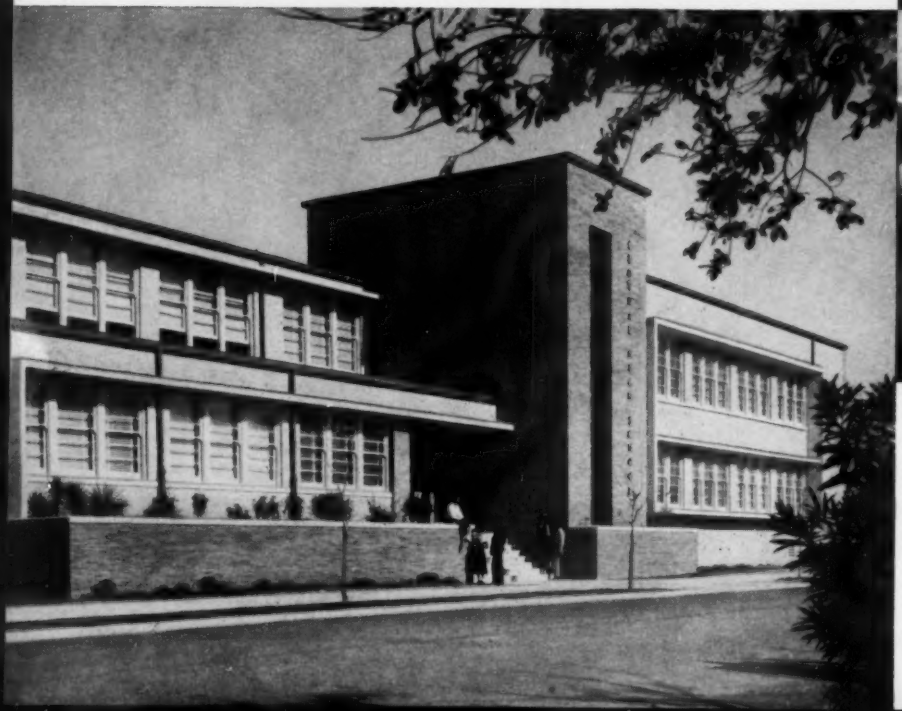
Plumbing and Heating Contractor
A. J. WARREN
Galveston, Texas

Powers automatic temperature control is used throughout both schools which are alike in facilities and general design. Both have modern gym, cafeteria, swimming pool and showers. Photos below indicate excellence of interior design.



Below: CENTRAL HIGH SCHOOL, GALVESTON, TEXAS

Drama and Public Speaking Classroom



Relaxation Area near Cafeteria Entrance

Maximum
Schoolroom Comfort and
Fuel Economy is
Assured by Powers Control

(c-15)

They kept it simple... in these modern Galveston schools

Heating . . . Ventilating . . . Showers . . . Water heaters are all regulated by

POWERS *Temperature Control*

One dependable Source, one responsibility, for satisfactory performance and service if required, is one of the many reasons why so many buildings are equipped throughout with Powers temperature control.

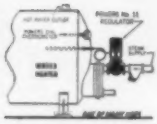
Chemistry Lab

Auditorium

Civics and History Classroom

Home Economics Classroom

Each School has Individual Room Control of heating and ventilating.



Powers No. 11 Regulators Control Domestic Water Heaters also Swimming Pool Heaters.

Boys and Girls Showers also are Thermostatically controlled by Powers

When you want automatic temperature control with the time-tested-and proven-dependable features of Powers regulation, call our nearest office or write us direct.

POWERS CONTROL

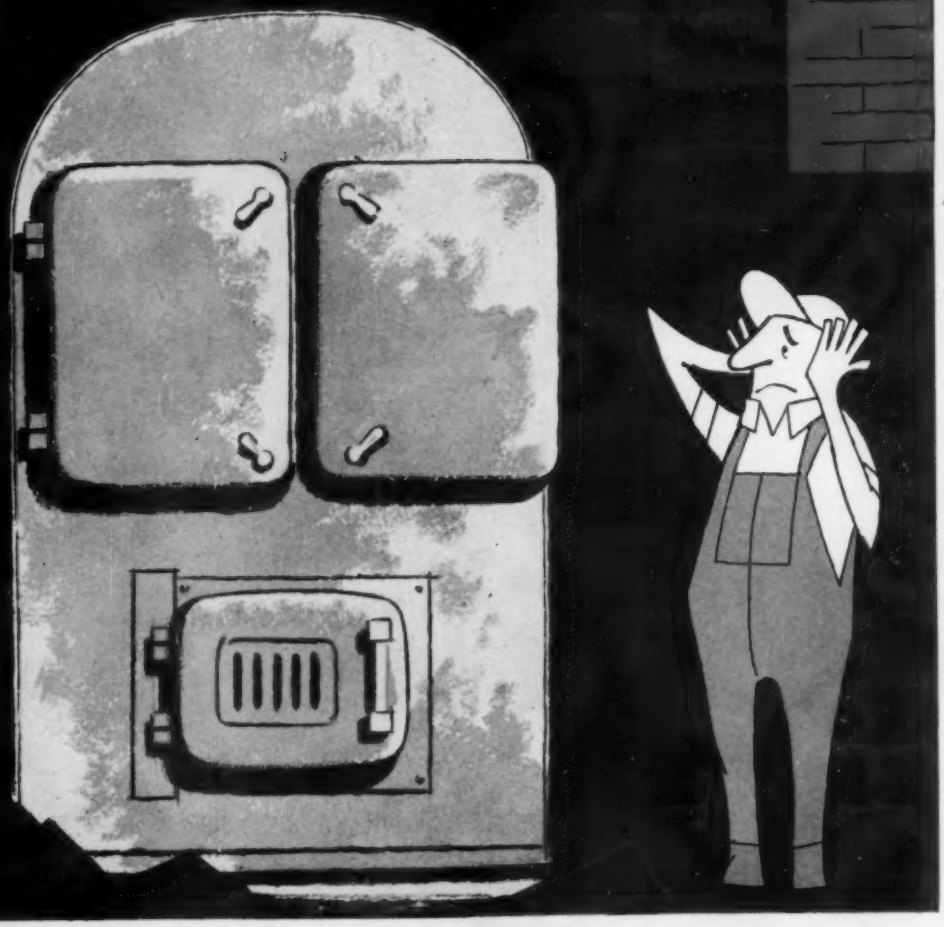
THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in chief cities in U.S.A., Canada and Mexico*

See your phone book

Over 60 years of Automatic Temperature and Humidity Control

Are excessive "entry" costs knocking down your replacement volume?



Think how many customers in your area would replace worn-out boilers if it weren't for excessive installation costs. *You can get these jobs* if you

install the unique

SPENCER "LW"

BUILT IN TWO SECTIONS—permits easier entry through narrow basement openings. Avoids costly tearing out of walls. The two water-tight sections can be moved in separately, yet require no welding for installation.

LOWER WATERLINE—overall height of the Spencer "LW" is approximately 25% less than that of conventional firebox boilers...makes possible its use in low-ceilinged basements...saves excavation expense!

LET SPENCER BUILD UP YOUR BOILER BUSINESS — WRITE DEPT. HP-45.

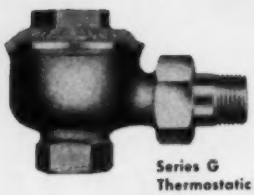
New Spencer "C". Heavy-duty commercial boiler performance at a residential boiler price! Can be fired with oil, gas or coal.

Spencer "A". Complete range of sizes from 3,500 to 50,000 sq. ft. steam, net SBI ratings. For *every* building... for *every* fuel.

SPENCER
HEATER
LYCOMING DIVISION
WILLIAMSPORT HYCO PENNSYLVANIA

ASME and SBI Approved.

SBI



Series G Thermostatic Trap

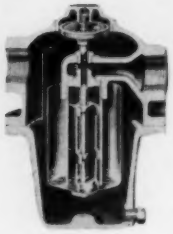
Standard Pressure Range 15 pounds to 25 inches vacuum

Series 45 Steam Trap

For pressures between 400 and 600 lbs. Body and Cover of special steel

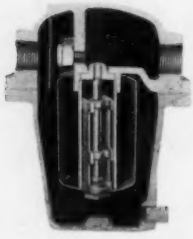
from 25" vacuum to 600 lb. pressure

illinois STEAM TRAPS



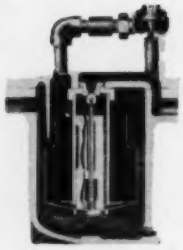
Series G Float and Thermostatic Trap

Standard Pressure Range 15 pounds to 25 inches vacuum



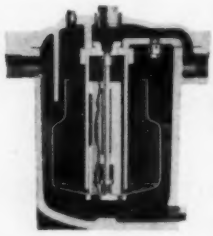
Number 30 Steam Trap

For Pressures up to 150 pounds



Series 36 Steam Trap

For pressures up to 30 pounds



Series 35 Steam Trap

For pressures up to 250 pounds

Prevent Steam Waste—Save Fuel

No matter what your condensate drainage problem may be—for low, medium or high pressure steam or compressed air service—there is an Illinois Trap exactly suited to do the job efficiently, economically. You have a wide variety of types and sizes from which to choose. Before your next trap purchase investigate Illinois with its outstanding record for preventing steam waste and saving fuel. The Illinois representative nearest you will furnish facts and figures—or write for bulletins.

1900 55 1955 YEARS illinois ENGINEERING DIVISION OF AMERICAN AIR FILTER INC.

illinois ENGINEERING

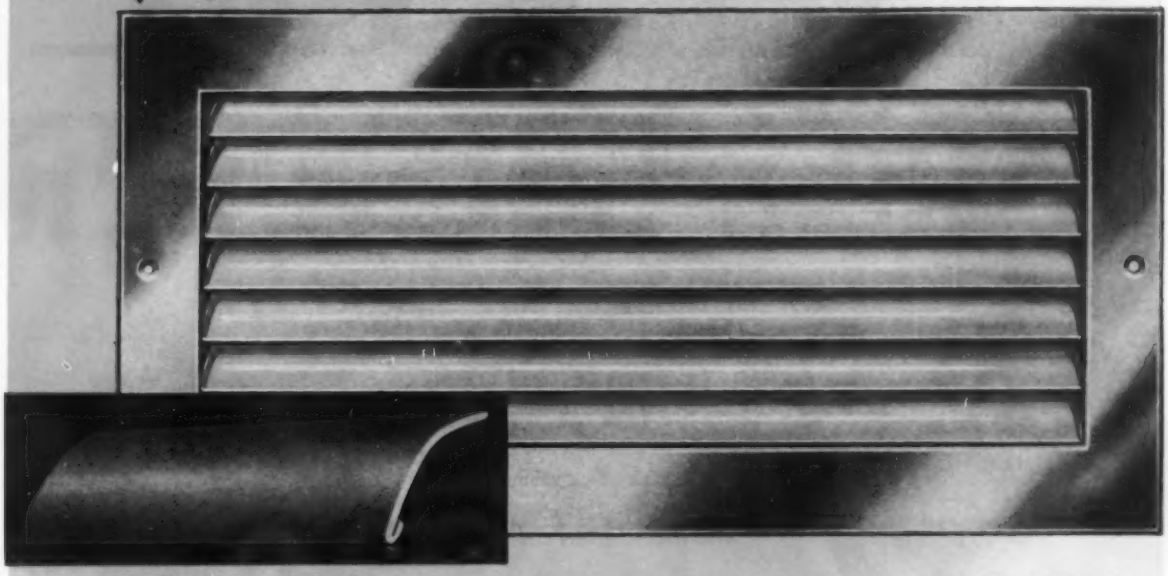
ILLINOIS ENGINEERING COMPANY

DIVISION OF AMERICAN AIR FILTER COMPANY, INC.

2035 SOUTH RACINE AVENUE • CHICAGO 8, ILLINOIS

NEW IMPROVED

Return Air Grille



CURVED HEMMED FINS GIVE 80% FREE AREA

TITUS

designed by

Large free area means the Titus Return Air Grilles HANDLE MORE AIR PER SQUARE INCH. Makes it possible for a smaller grille to give superior performance . . . at lowest cost . . . and correct performance faults of other parts of an air conditioning or heating system . . . at the same time.

NEW BEAUTY

Matches design of supply grilles. Curved outline of fins add beauty . . . at the same time make it easy for maintenance personnel to keep grilles clean.

ONE-PIECE ASSEMBLY . . . FOR ANY SIZE OPENING

This eliminates expensive labor of handling old-fashioned grilles that are made in sections. Cuts costs of fitting, butting and screwing together these sections. Brings labor and grille costs to a minimum.

MORE STRENGTH PER SQUARE INCH

The curved hemmed fin design adds rigidity and durability to resist lower wall abuse. There is no see-thru due to the special positioning of the fins.

WRITE FOR FREE CATALOG TODAY

TITUS MANUFACTURING CORP.
WATERLOO, IOWA

Gentlemen: I wish to improve the heating and air conditioning performance of my forced air systems . . . at the same time lower my grille costs. Please send me the new illustrated brochure on Titus Return Air Grilles.

Name _____

Company _____

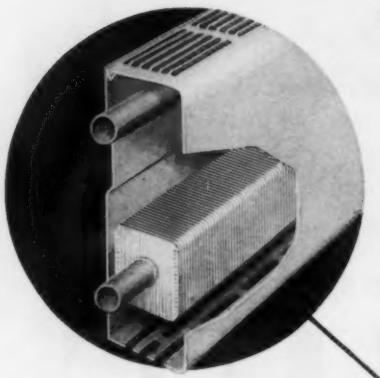
Address _____

City _____ State _____

a new major advancement...

Nesbitt

SERIES HOT WATER



Nesbitt Wind-o-line comes in attractive wall-hung enclosure or recessed in storage cabinets of The Nesbitt Package

Nesbitt Syncretizers and Wind-o-line may now be combined in a forced hot water heating and ventilating system in which the *Wind-o-line tubing becomes the supply and return main* to the Syncretizer in a series of classrooms—thus saving on construction, equipment, and installation costs.

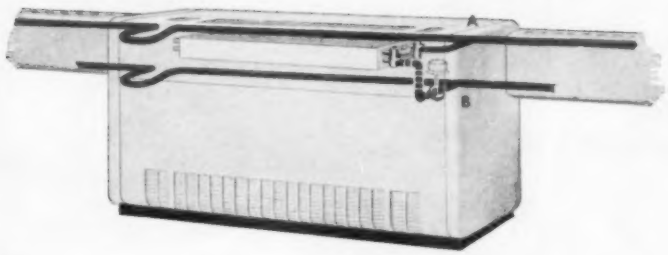
In this series system the water temperature at all times is related to the outdoor temperature, thus improving the individual room temperature control provided by the Syncretizer, and the protection against cold surfaces furnished by the Wind-o-line.

Telephone, wire, or write today for more information:

school mechanical system costs **reduced**

classroom comfort and protection **increased**

WIND·O·LINE SYSTEM



Packaged piping reduces installation cost. (a) Crossover return tubing, expansion loop, and air vent fitting come pre-assembled and connected to the heating element. (b) Crossover supply tubing, expansion loop, and balancing valve are furnished installed, leaving a minimum of piping at the site.

IF YOU are interested in school construction costs, it will pay you to study how this latest Nesbitt development meets today's needs and gives more for the school-building dollar.

In forced hot water applications Nesbitt Syncretizer heating and ventilating units with Wind-o-line radiation may be installed in series-loop circuits, in which the copper tubing of the Wind-o-line system serves as the only required supply and return piping for multiple-classroom groupings or entire wings.

COSTS REDUCED *Savings in equipment:* Smaller pipes and pumps are required because the Nesbitt System is designed to provide the needed heating capacity with water quantities of from one half to one third those required in conventional systems. Saves on both first cost and operating cost.

Savings in construction: Wind-o-line supplies Syncretizers, eliminating costly pipe trenches, mains, runouts and pipe covering in much of the building. Other piping is simplified.

Savings in installation: Mains and piping are smaller, shorter, simpler. Packaged piping within the Nesbitt Syncretizer unit ventilator reduces installation labor at the site. See above.

COMFORT INCREASED *Variable water temperature control:* Relating the available heat directly to outdoor temperatures improves the control of individual room temperature by the Syncretizer.

Improved cold surface protection: Because the system water temperature increases as outside temperature falls, Wind-o-line protection against cold window downdraft and bodily heat loss is continuously related to actual needs.

Off-time temperature maintenance: Without additional investment in equipment, the Nesbitt System maintains safe basic building temperatures during overnight, holiday, week-end shutdowns.

The Series Wind-o-line System offers you these

advantages

Better room temperature control

Increased protection against cold surfaces and window downdraft

Costly pipe trenches eliminated

Pipe covering and traps eliminated

Smaller pumps cost less, operate with greater economy

Shorter, simpler mains and piping

Packaged piping in the Syncretizer reduces installation costs

No extra controls and equipment required for night heating

Made and sold by John J. Nesbitt, Inc., Philadelphia 36, Pa. -- Sold also by American Blower Corporation

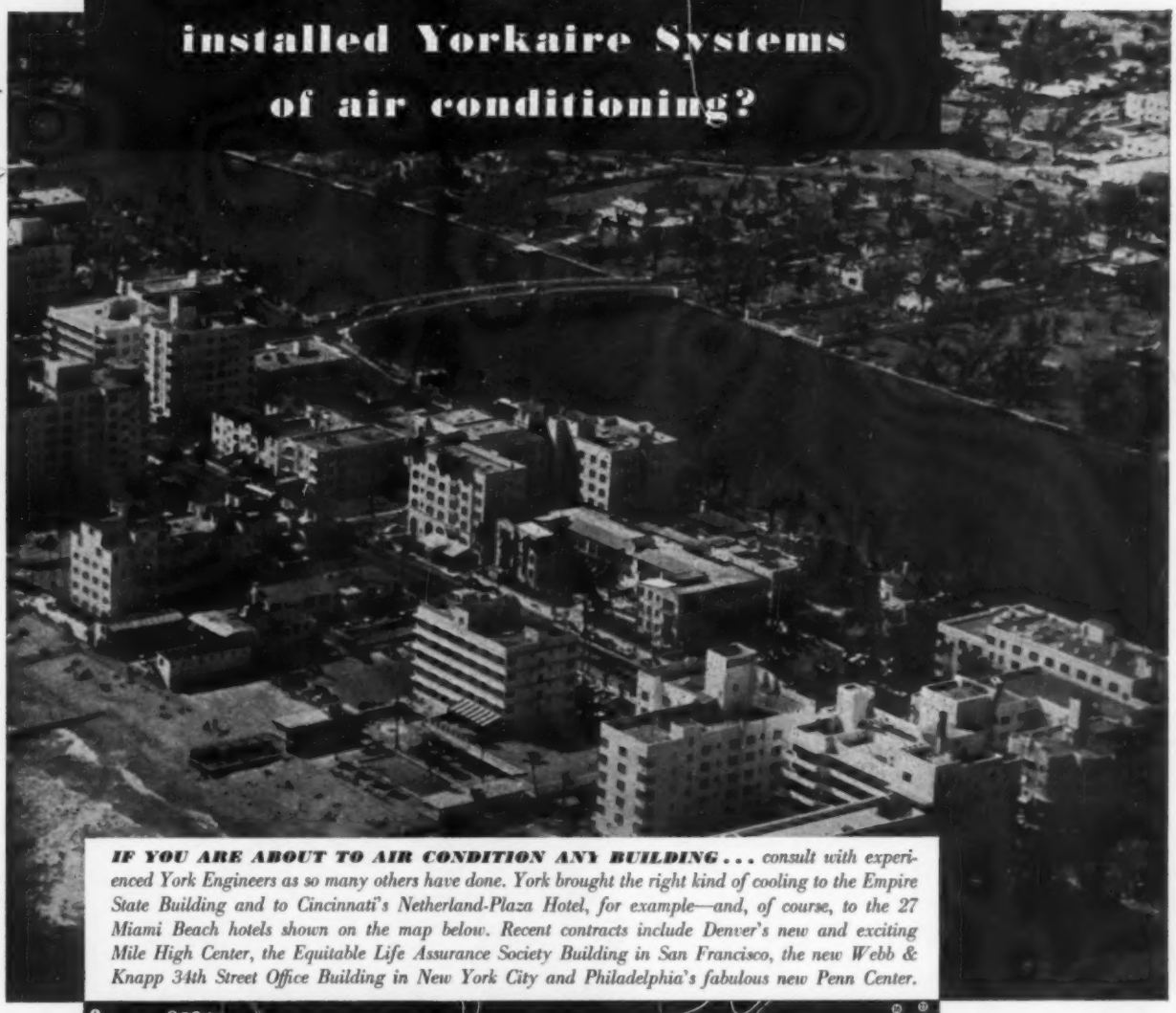
AMONG SEVERAL REASONS IS THIS IMPORTANT ONE: a Yorkaire System is the *right kind* of air conditioning . . . custom-tailored to the building.

That's why you'll find York cooling in 27 of Miami Beach's largest, best hotels (not to mention the leading hotels in Miami proper). As in all large buildings, glass areas and heat loads and floor areas and numbers of rooms, economic considerations, taxes, depreciation and many other factors varied from hotel to hotel, up and down the Beach. So obviously no one system—or even two or three —could do the job best for every hotel. That's why York engineered each system to fit the particular hotel in which it is installed.

You can apply this knowledge and experience to your building by calling your York District Office (located in principal cities and listed in the classified phone book). York Corporation, York, Pa.

HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885

Why have 27 of Miami Beach's largest, newest hotels installed Yorkaire Systems of air conditioning?



IF YOU ARE ABOUT TO AIR CONDITION ANY BUILDING . . . *consult with experienced York Engineers as so many others have done. York brought the right kind of cooling to the Empire State Building and to Cincinnati's Netherland-Plaza Hotel, for example—and, of course, to the 27 Miami Beach hotels shown on the map below. Recent contracts include Denver's new and exciting Mile High Center, the Equitable Life Assurance Society Building in San Francisco, the new Webb & Knapp 34th Street Office Building in New York City and Philadelphia's fabulous new Penn Center.*

York refrigeration air conditioning

YORK CORPORATION

the quality name in air conditioning

HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885

One reason Westinghouse Air Conditioning lasts longer and needs less maintenance is the Underwater Leak-Test, shown at left. Before leaving the factory, every compressor is submerged in water under 300 lbs. of air pressure to test for leaks. The result . . .

12 Years of peak-load

AIR CONDITIONING

with unbelievably little maintenance

In 1942, the Boeing Airplane Company, Wichita, Kansas, installed a Westinghouse Air Conditioning System. For the next four years, defense work required round-the-clock operation, nine months of the year. Today, 12 years later, the system still operates 16 hours a day, six months of the year.

But more important, of the four original Westinghouse Compressors that make up the heart of the system—two still have their original factory seal unbroken. The total maintenance during the entire 12 years, on all units: just four crank-case oil changes; and only six valve plates changed.

HELPFUL GUIDE TO COMPLETE WESTINGHOUSE LINE

. . . ***Yours for the asking.*** To show you at a glance the complete range of Westinghouse equipment, Westinghouse offers a handy reference folder on commercial and industrial air conditioning. Covers Unitaire® package units, heat pumps and components for field-assembled installations. For your free copy, write directly to:

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2. **Ease of fabrication by almost all known methods**
3. **Excellent electrical and thermal conduction properties**
4. **Ready availability that recommends Hussey Copper as standard**

Hussey Copper offers you all these features plus dependable top quality and uniformity that makes it advantageous to always specify "Hussey Copper." Mill service is available on mill-run quantities including finishing services such as shearing, slitting or special heat treating. For stock items call on any of the seven complete Hussey Copper Warehouse stocks listed below.

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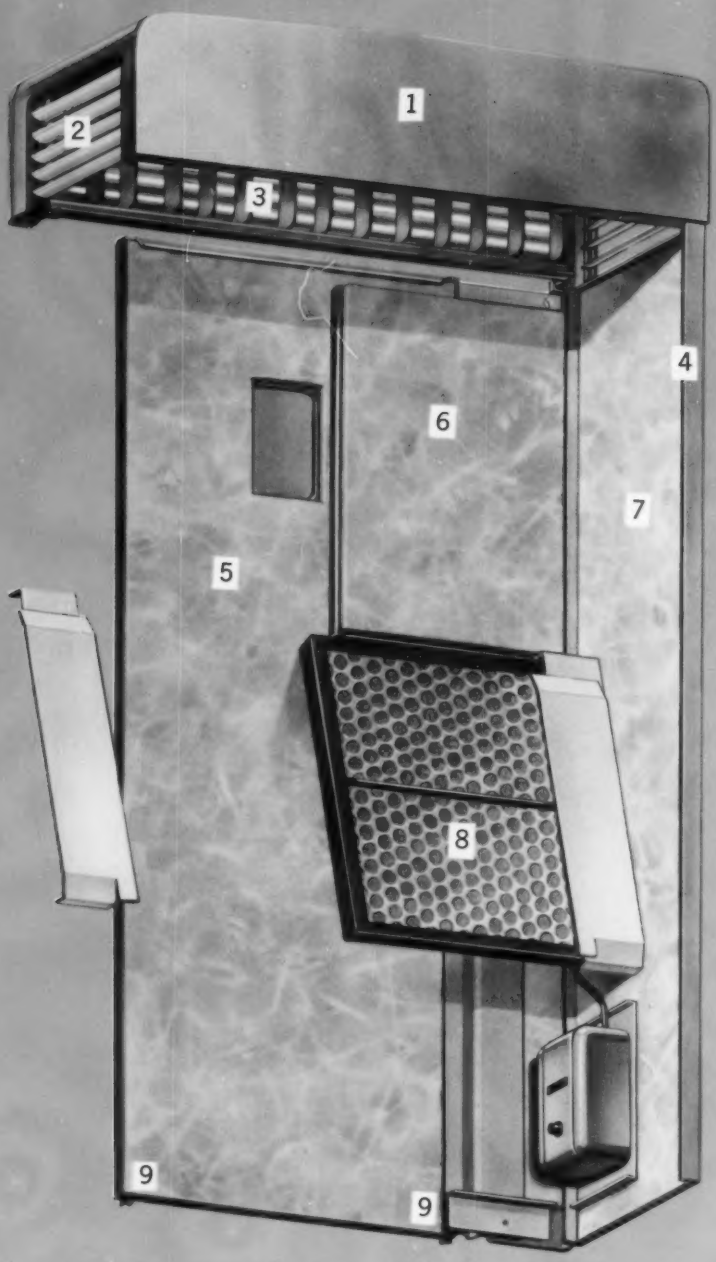
PACKAGED AIR CONDITIONERS

for an ideal indoor climate in stores, offices, factories



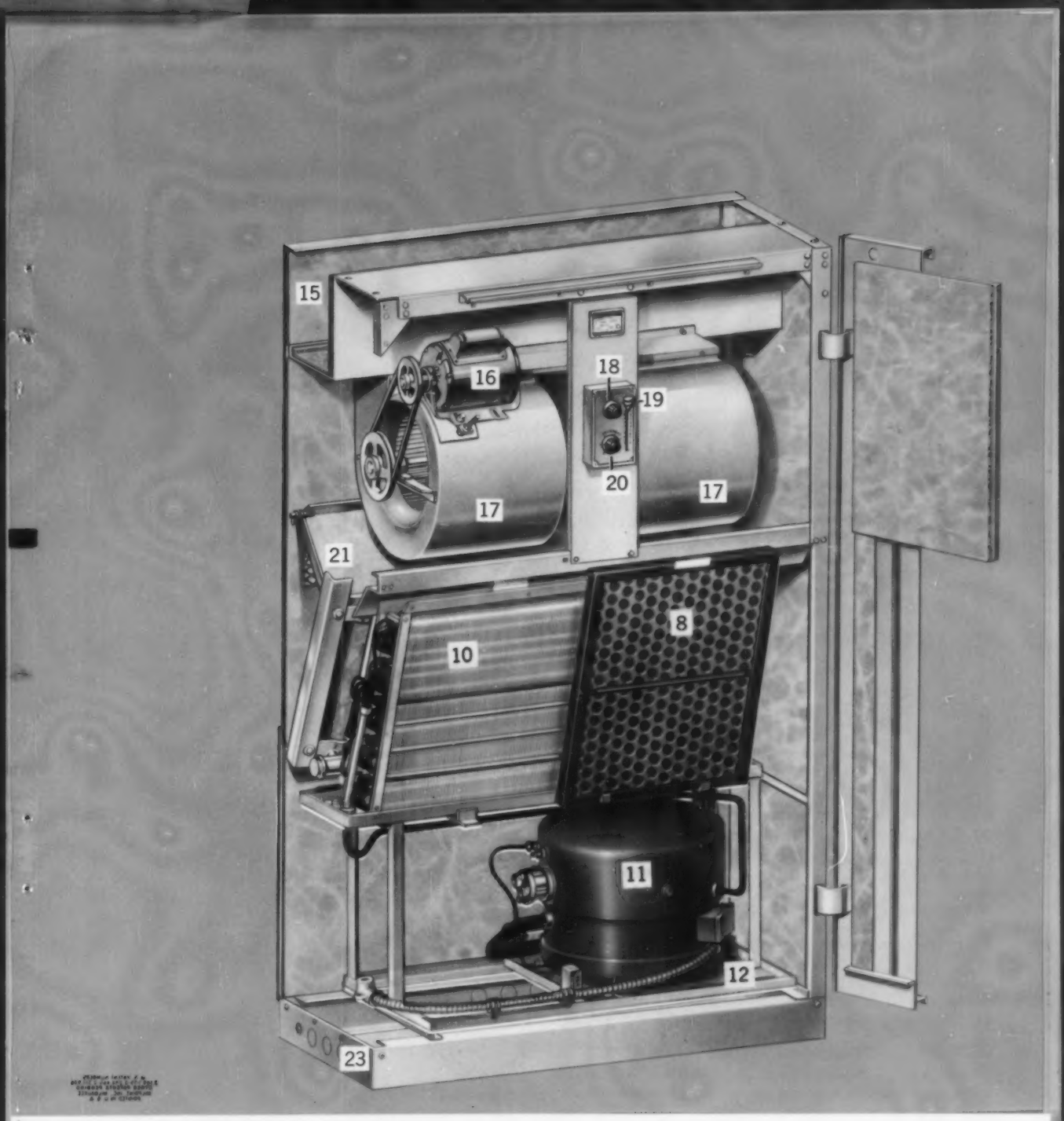
NEW ADVANCED DESIGN

General Electric Packaged Air Conditioners are completely self-contained units that provide all the functions of modern air conditioning. The results of many years of G-E engineering research and development, they feature a new advanced design in styling and construction that combines beauty with unparalleled dependability and performance.

This Trans-Vision is being presented so that you can "see through" to the built-in product advantages of the outstanding new General Electric Packaged Air Conditioners.

Flexible Air Distribution. The air distributor (1) is an integral assembly, shipped in one piece, ready for mounting. By means of the horizontal louvers (2) on the front and sides, as well as the adjustable vertical vanes (3), three-dimensional distribution can be obtained — quickly and easily.

The entire cabinet (4) is of rugged steel, providing structural support, as well as covering — skin-stressed like an airplane — to give greater strength with less weight. The front panel (5), when in place on the wing panels, the left one of which is shown at (6), forms two vertical air inlets —

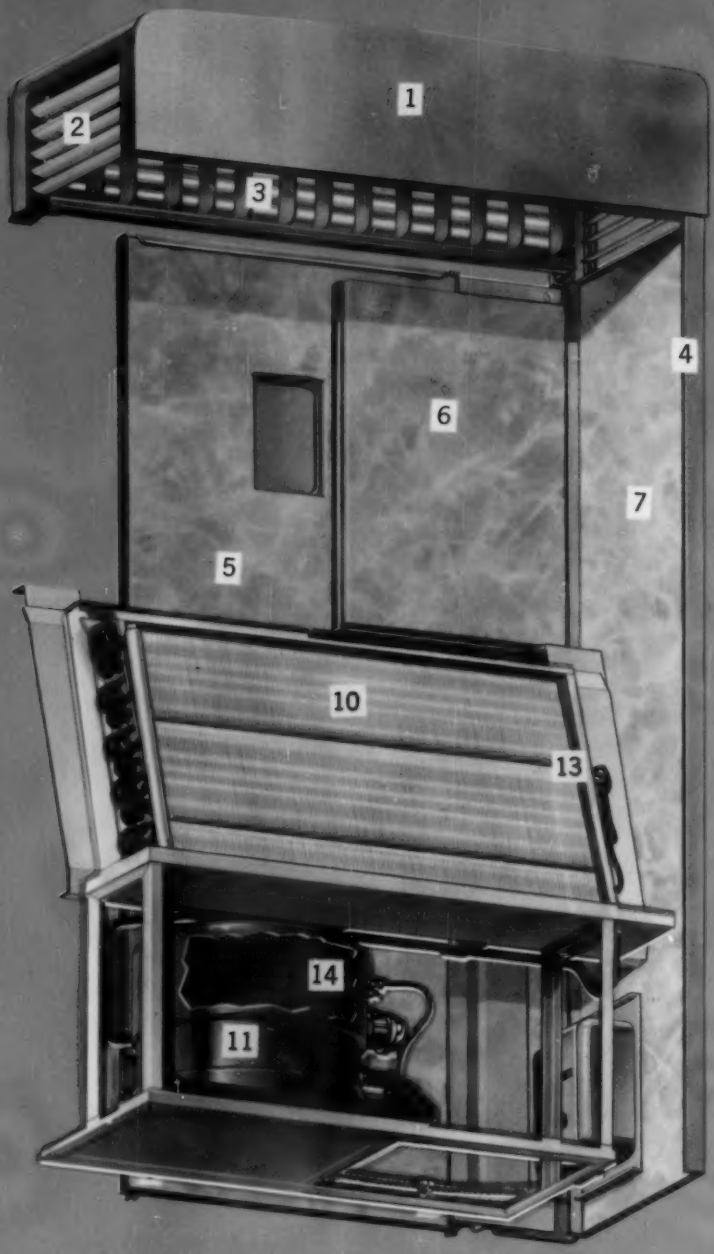


one at each side of the front panel, thereby eliminating the old-fashioned, dirt-collecting air intake grille. This panel is easily removed simply by loosening the two wing-nuts (9) and lifting the panel off.

All inside surfaces are insulated with a special soft-grade type of fiber-glass blanket (7), which prevents sweating and deadens sound. In addition, this blanket is vermin-proof, fire-proof, and mildew-proof.

The filters (8) filter the air entering the unit, either fresh or recirculated. Clip mounted — they are easily removed in less than a minute. Replacements are readily obtainable because they are a standard commercial type of viscous-coated glass wool.

All-in-One Cooling System. Here is real servicing simplicity: the complete cooling system, consisting of the evaporator (cooling coils) (10) and the refrigeration unit (11) are mounted on a welded steel frame (12) as an integral assembly. The entire system can be easily withdrawn from the front of the unit after breaking four connections: the electrical BX, the two water lines to the condenser, and the condensate drain line.

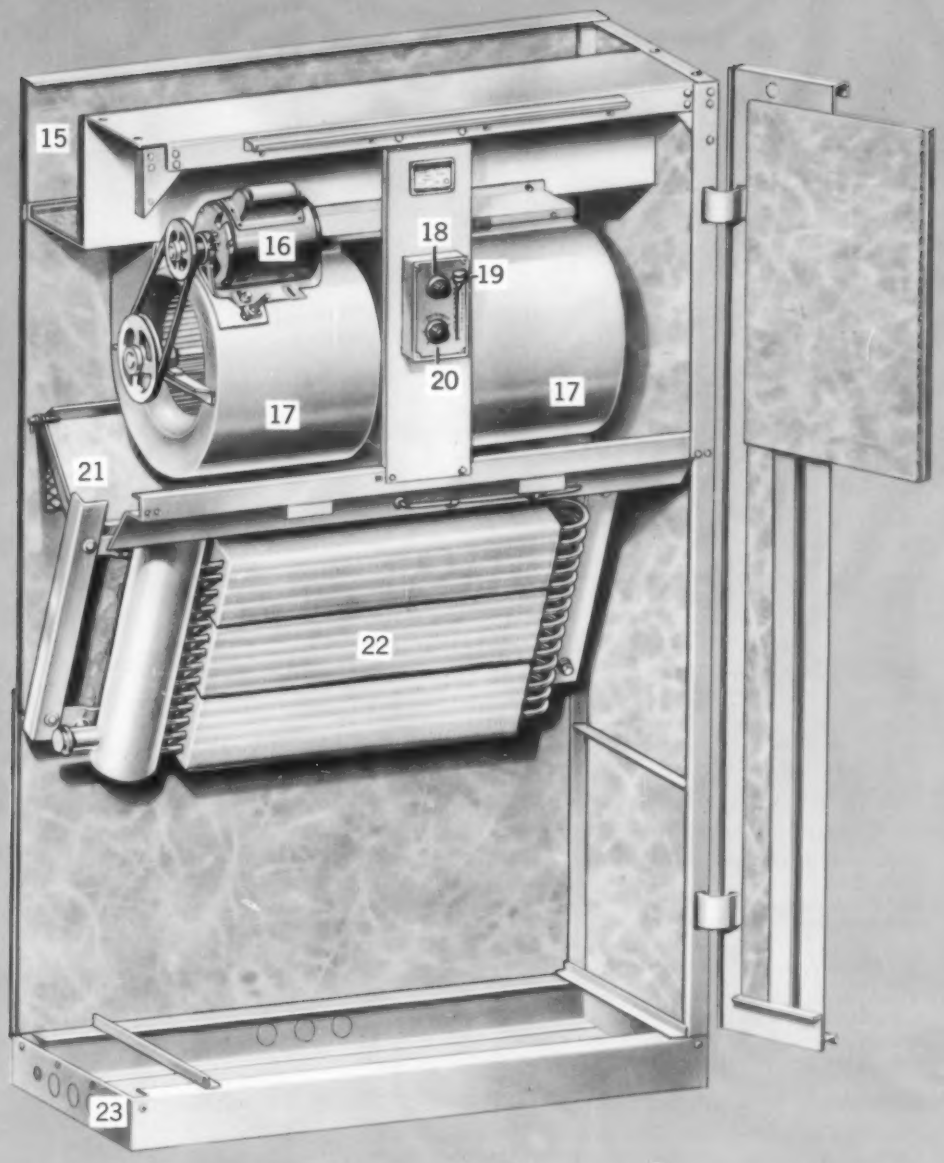


Advanced Thermodynamic Design. All the latest advances and techniques in thermodynamic design are applied to this heat exchanger — the G-E extra-large evaporator (10). The conventional expansion valve has been replaced by capillaries (13), insuring proper distribution of refrigerant to all sections of the evaporator. G-E cooling coils wring out all the Btu's and moisture the air conditioner is rated to remove.

The compressor, compressor motor, and condenser coils (14) are all enclosed in a sealed housing, providing a compact, simple, refrigeration unit (11).

The entire cooling system is submitted to many strenuous tests, including the famous "dunk" and mass spectrometer tests.

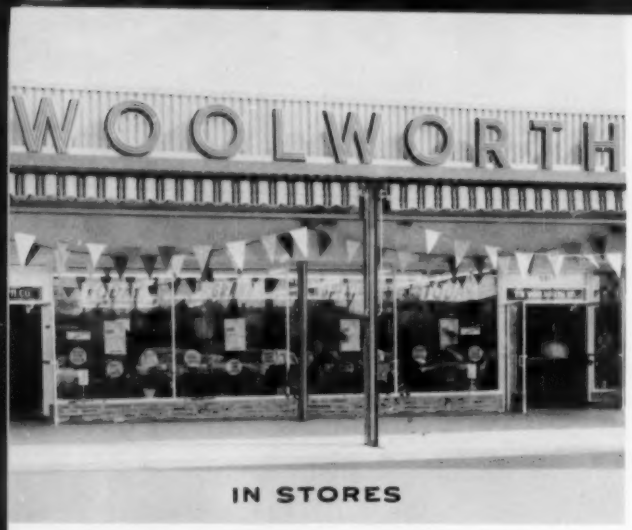
Quiet Operation. The acoustically designed air distribution chamber (15), along with the resilient mounted fan-motor (16) and the whisper-quiet fans (17), reduce noise to an unheard of level.



The control panel concealed behind the access door on the front panel, provides a simple and flexible control that anyone can operate. The upper dial (18) controls the fan and compressor motors for either circulation or cooling. The lower dial (20) controls the setting of the thermostat to give the desired temperature. The muggy weather control (19) mechanically operates the damper (21) to permit a controlled portion of air to by-pass the cooling coil. Air flowing over the cooling coils is slowed down, permitting the coils, on muggy days, to extract more moisture.

By the addition of an optional G-E steam or hot water heating coil (22), the unit can be utilized for year 'round air conditioning, cooling, tempering, or heating.

Connections to the conditioner can be made via knock-outs (23) in either side or rear of the base or through the bottom panel.



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1. Complete Sealed-In-Steel Protection!

G. E. seals in savings, seals out trouble. Only G. E. seals-in-steel, tight as a light bulb, all three vital cooling system parts — motor, compressor, and condenser — not just motor and compressor as in other makes.

2. Five-Year Investment Protection!

These units are so risk-free, you get an unprecedented warranty. G. E. will replace the entire all-in-one cooling system at no cost to you, if necessary at any time during full 5-year warranty period.

3. Modern Streamlined Styling!

They look as good as they make you feel! From the unique vertical air inlets . . . to the two-toned, silver-gray finish . . . the distinctive, compact G-E cabinet graces every interior and lends an air of crisp, modern efficiency.

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New research institute building . . .

Take a good look at one of the country's most modern research institutes, soon to be completed in Kansas City, Missouri. It's the new building of the Midwest Research Institute, a non-profit organization that in the last decade has made outstanding contributions to the development and growth of midwestern industry and agriculture.

Heated piping in the new M. R. I. building* is insulated with G-B Snap*On, the new one-piece molded pipe insulation of fine glass fibers. Highlight features of Snap*On are its superior thermal efficiency, extreme ease of application, and its rugged durability. Lightweight Snap*On, in 6-foot sections with a single seam, were snapped on the pipe in a fraction of the time it takes to apply conventional segmented insulations. There was virtually no waste or breakage, for Snap*On is a rugged, resilient material that will not chip, flake, break or crumble.

Snap*On is available in sizes from ¾" to 33", and in varying wall thicknesses. If you have a job on the boards that calls for insulation of chilled or heated piping where temperatures do not exceed 350°F., see Sweet's File (Architectural) for complete data on this revolutionary new pipe insulation. Or better yet, call your local G-B distributor who maintains local stocks of Snap*On. He's listed in the Yellow Pages in 57 cities.

*Architect: Neville, Sharp & Simon; contracter: Collins Construction Co.; insulation contractor: Kelly Asbestos Co.; mechanical engineers: Howarth, Scott & Kinney.

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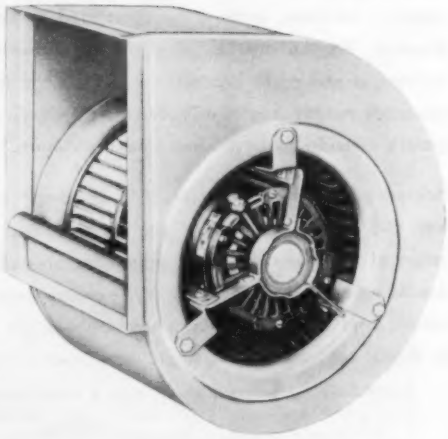

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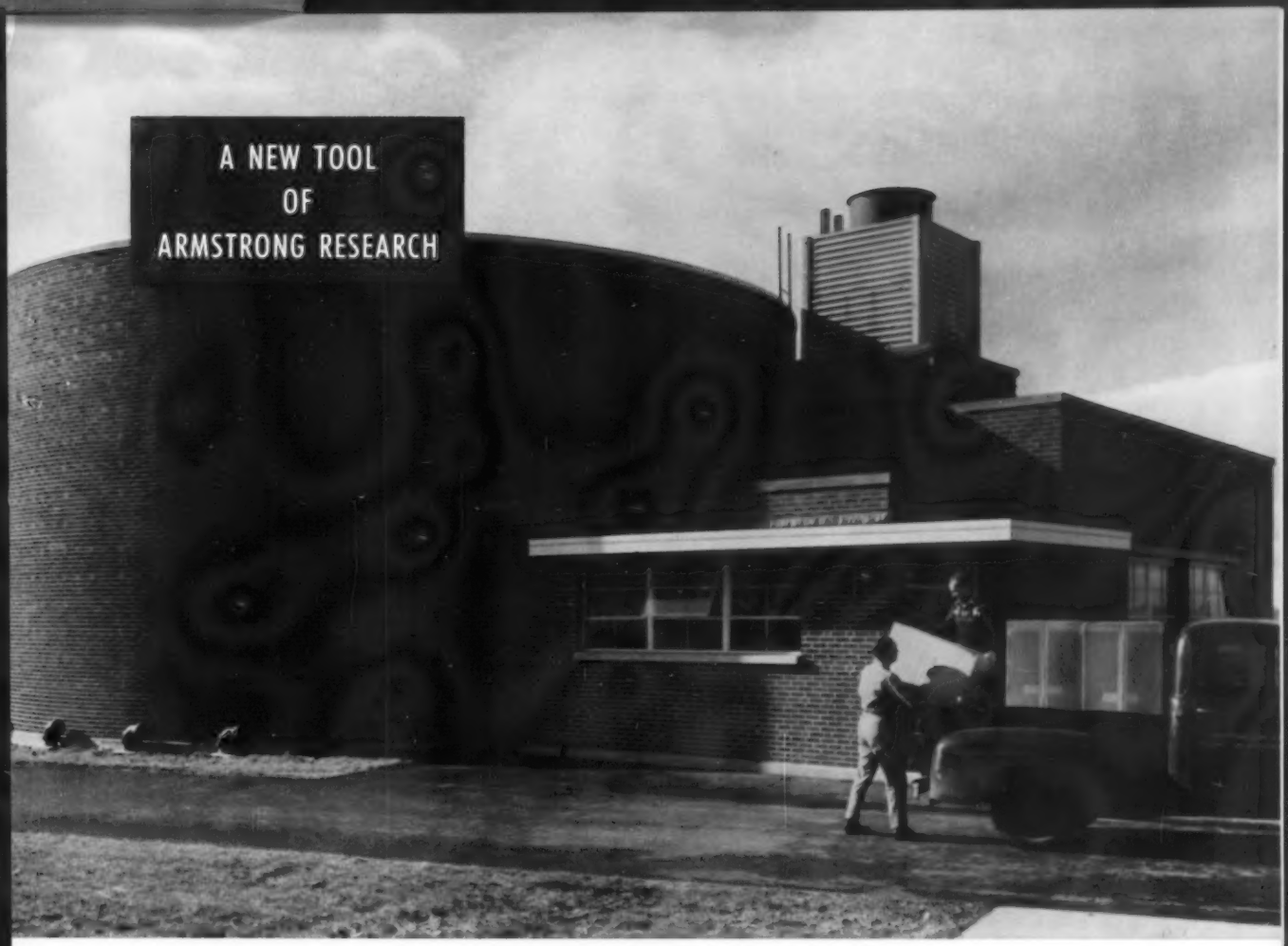


Test Chamber • • • *unique facilities can duplicate any operating conditions for industrial insulations*

All kinds of insulated constructions can be tested under controlled interior and exterior temperature and humidity conditions in this new Armstrong laboratory building. Almost any service condition can be exactly duplicated.

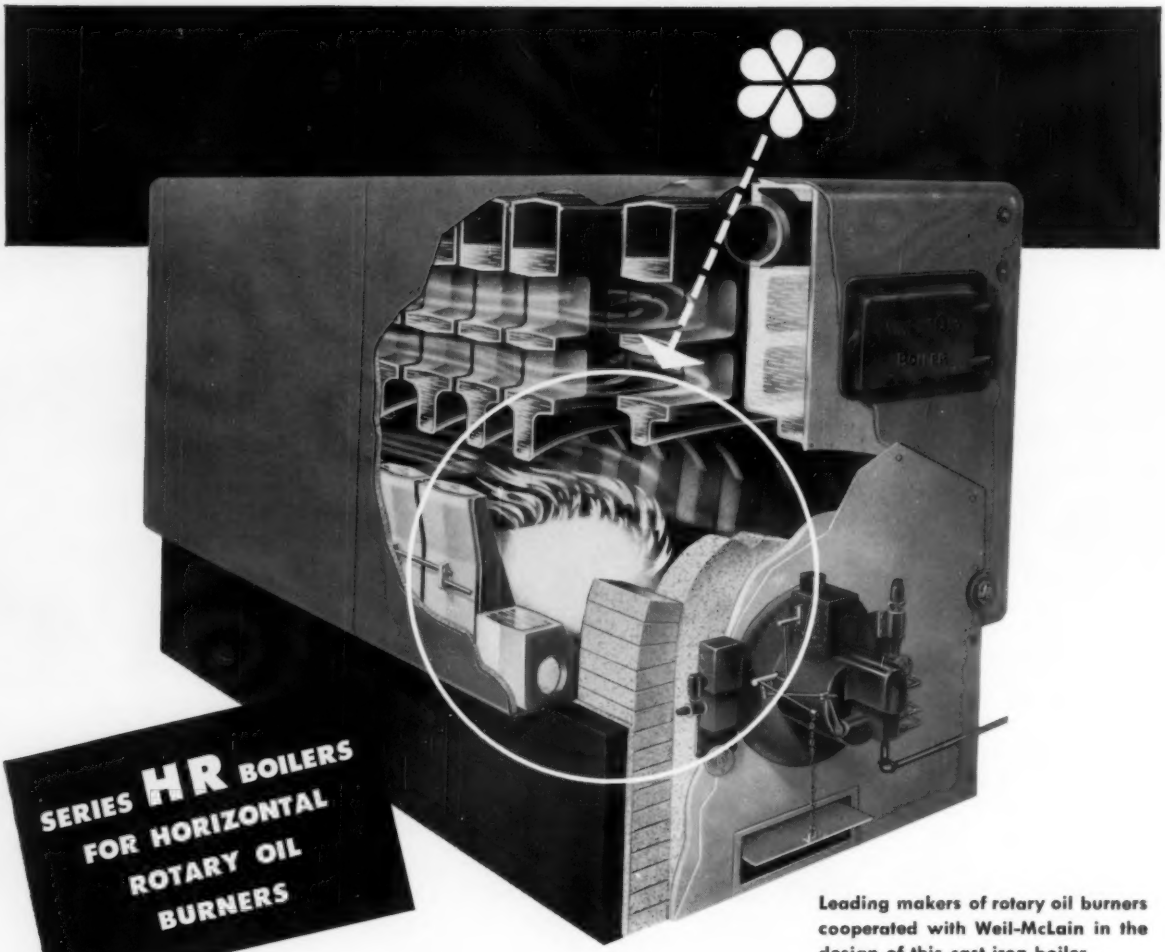
The large circular chamber can be held at temperatures ranging from 0° to 160° F., with humidities accurately controlled from dry to practically saturated conditions. Complete test rooms are then built inside this controlled chamber and operated at temperatures from 100° below zero to 200° F. This flexible arrangement permits accurate control of conditions on both sides of an insulated wall.

This Armstrong laboratory building is just one tool constantly being used in a continuous program of research . . . a program that is steadily improving insulation materials and techniques used in applying them.

If you would like help in the solution of an insulation problem—or full details on the Armstrong Line of industrial insulations and Contract Service—call your nearest Armstrong office or write Armstrong Cork Company, 207 Stratton Street, Lancaster, Penna.

Armstrong INDUSTRIAL INSULATIONS

To test insulating specifications on various wall constructions, insulations are applied to a test room within the large circular chamber. Temperatures and humidities on both sides of the wall can duplicate almost any set of conditions.



Leading makers of rotary oil burners cooperated with Weil-McLain in the design of this cast iron boiler.

Within the circle above, you'll find the features which make the Weil-McLain HR Series Boiler a revolutionary advance in heavy oil burning efficiency.

Note first the fire box. Its extra large combustion volume assures lower heat release per cubic foot... maximum radiant heat transfer...higher CO_2...and more complete, smoke-free combustion. Large waterways permit rapid, efficient water circulation through the boiler.

The heavy steel front plate is a special feature which greatly simplifies burner installation. It is furnished blank with a scribed center line for easy location of the various openings required. Or, if requested, the factory will furnish the plate drilled and tapped to specification.

HR Series Boilers have sturdy steel, green enamelled jackets lined with heavy density fibre glass...saves insulating time on the job.

This boiler is built of rugged *cast iron*—strongly resistant to the corrosive effects of the large sulphur content of heavy oils. Its sectional construction and short individual draw rods assure easier erection and a more flexible assembly. Note, too, the high base—it eliminates a high brick foundation.

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For complete information, send for Bulletin No. C-188

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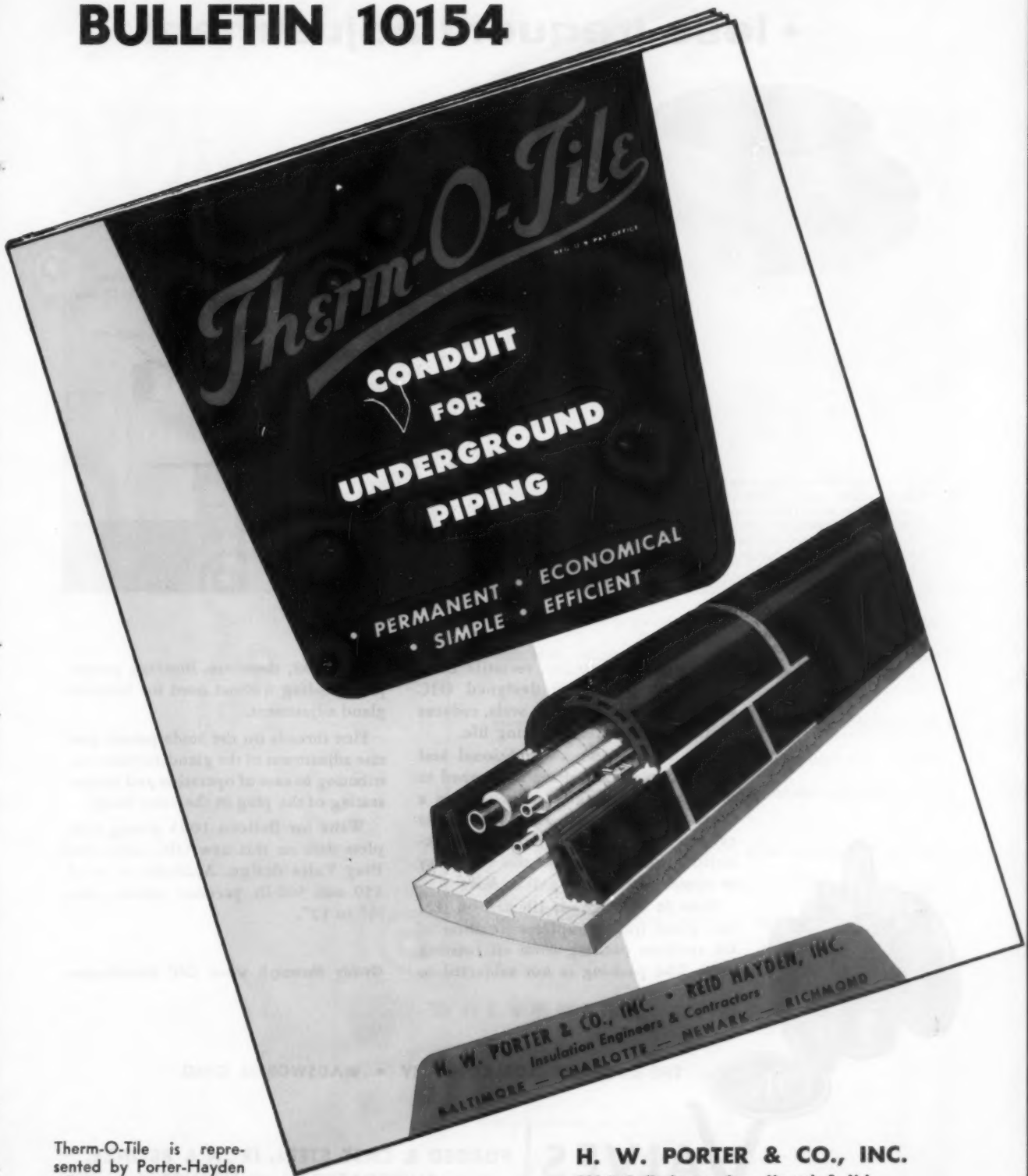
Therm-O-Tile

BULLETIN 10154



Therm-O-Tile is represented by Porter-Hayden offices as listed at the right, and, Johns-Manville Technical Service Units in all principal cities. Address all inquiries to H. W. Porter & Co., Inc., 822-H Frelinghuysen Ave., Newark 5, N.J.

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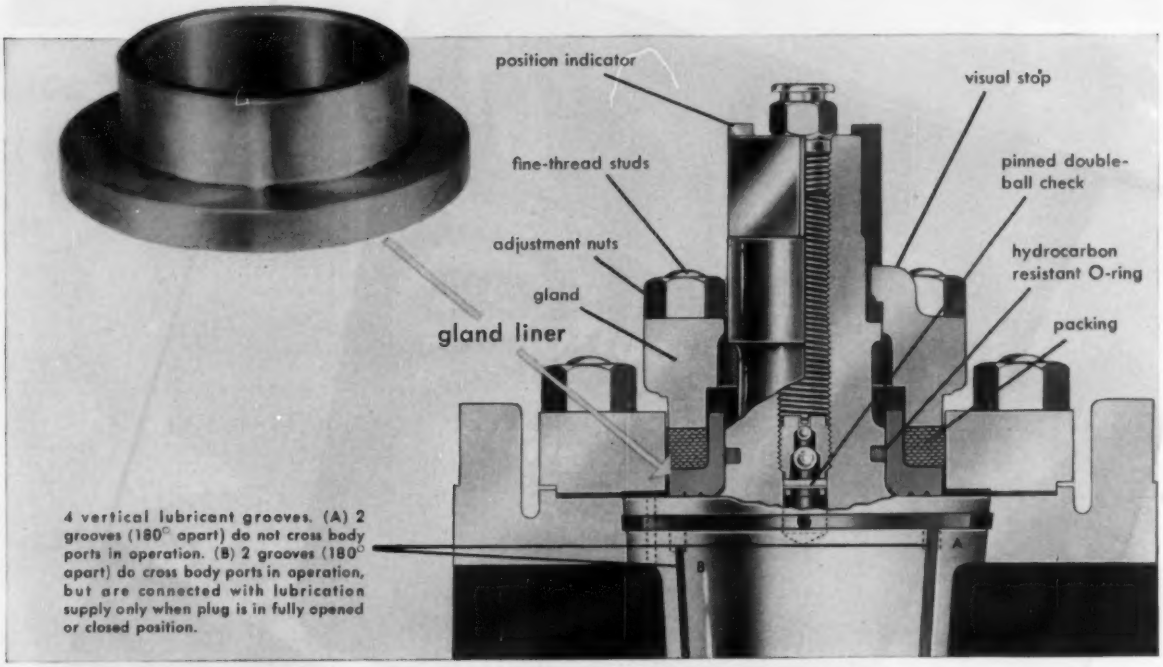
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visual stop
fine-thread studs
pinned double-ball check
adjustment nuts
hydrocarbon resistant O-ring
gland
packing
gland liner
4 vertical lubricant grooves. (A) 2 grooves (180° apart) do not cross body ports in operation. (B) 2 grooves (180° apart) do cross body ports in operation, but are connected with lubrication supply only when plug is in fully opened or closed position.

It's the gland liner . : . versatile component of the newly designed OIC Lubricated Plug Valve. It seals, reduces friction, helps extend packing life.

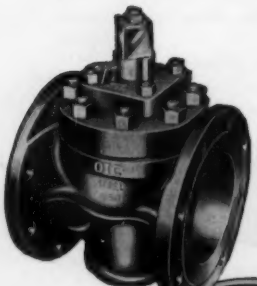
This liner forms an additional seal where its mating surfaces are lapped to the top of the plug. Machined from a special bronze—OIC Alloy 40—it has extremely low friction bearing characteristics, helping to make this valve easy to operate. It will not gall or seize.

Note in the cutaway illustration that this gland liner completes isolation of the resilient packing from all rotating parts. The packing is not subjected to undue wear, therefore, insuring proper plug loading without need for frequent gland adjustment.

Fine threads on the studs permit precise adjustment of the gland, further contributing to ease of operation and proper seating of the plug in the valve body.

Write for Bulletin 1003 giving complete data on this new OIC Lubricated Plug Valve design. Available in steel, 150 and 300-lb. pressure classes, sizes ½″ to 12″.

Order through your OIC Distributor.



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Amer. Soc. Heat. Vent. Engrs.	(Weight)	Artificial	97%
Natl. Bureau Stds.	(Dust-Spot)	Artificial	58%
Natl. Bureau Stds.	(Dust-Spot)	Natural	12%

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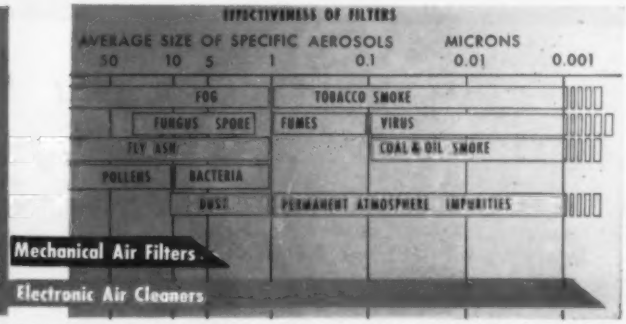
ELECTRONIC AIR CLEANERS

	Test Method	Test Dust	Efficiency
Amer. Soc. Heat. Vent. Engrs.	(Weight)	Artificial	99%
Natl. Bureau Stds.	(Dust-Spot)	Artificial	98%
Natl. Bureau Stds.	(Dust-Spot)	Natural	90%



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for every installation

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QUIET OPERATION

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ELECTRIC MOTORS
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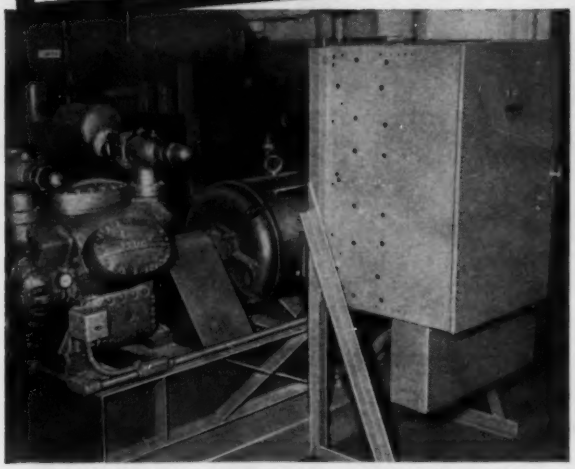
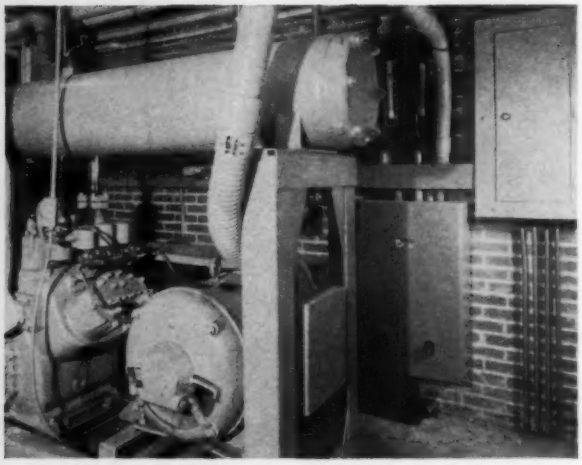
Start Squirrel-Cage Motors THE MODERN WAY



This 100 hp 3 step increment start motor, with double extended shaft, drives two refrigeration compressors in an Atlanta hospital.



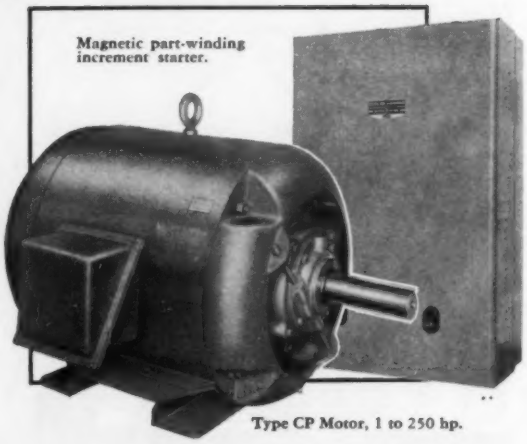
A 40 hp open type high torque motor with an increment starter, drives this compressor in a Houston office building.

with the Wagner Increment Motor and Starter Combination

You benefit when you install a Wagner Increment Motor and Starter "package" because you get a most economical, highly efficient motor and starter combination that limits inrush of motor current to values that are acceptable for the distribution systems of most power companies.

Wagner two-step starter combinations are suitable for most applications. A three-step increment starter is available for applications calling for unusually low inrush of starting current.

Your nearby Wagner engineer will be glad to help you select the combination that meets *your* requirements. Call the nearest of our 32 branch offices, or write us.



Magnetic part-winding increment starter.

Type CP Motor, 1 to 250 hp.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6370 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

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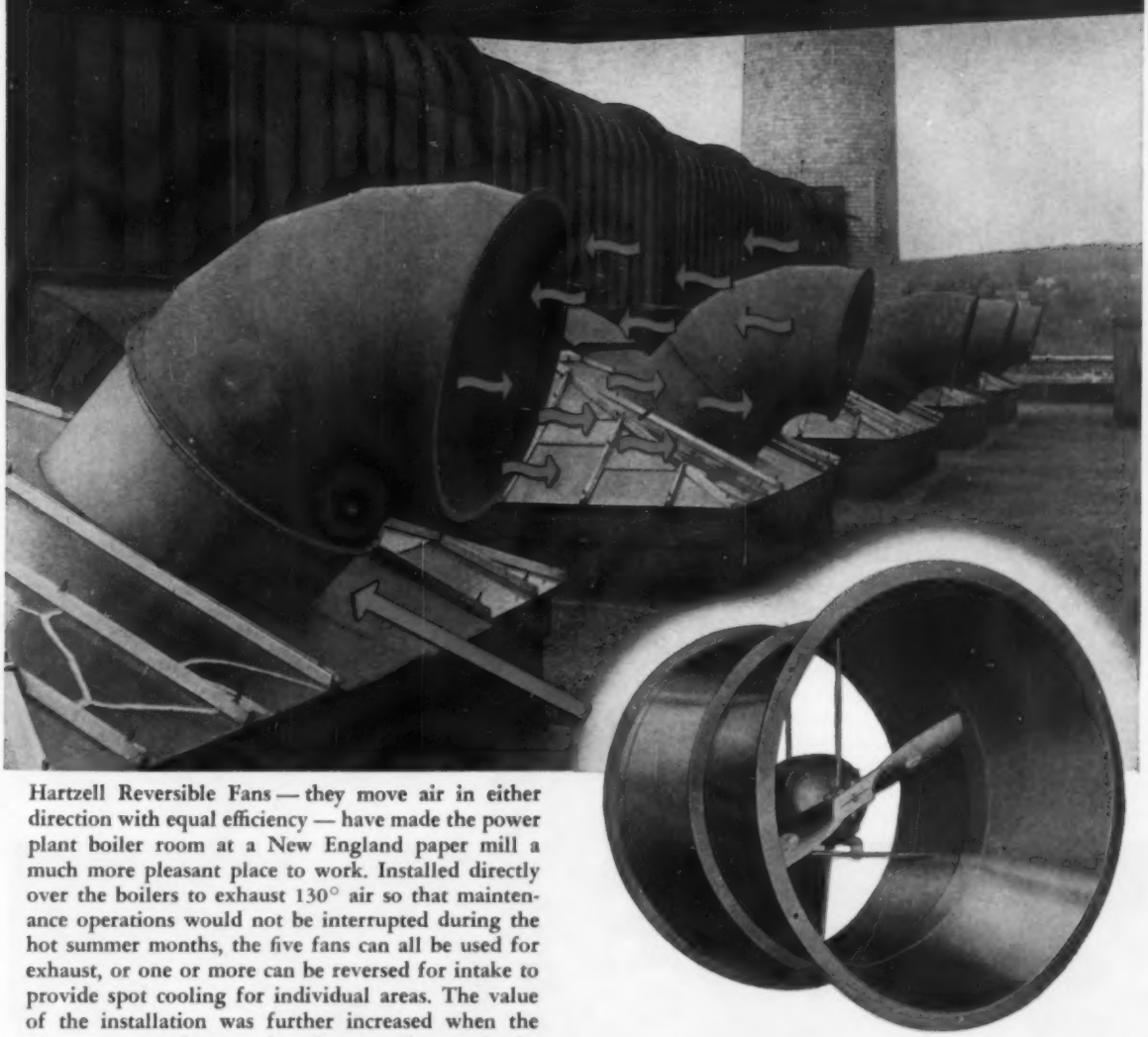
ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

M54-14

Hartzell *Reversible* Fans carry a double burden in the power plant at this New England paper mill



Hartzell Reversible Fans — they move air in either direction with equal efficiency — have made the power plant boiler room at a New England paper mill a much more pleasant place to work. Installed directly over the boilers to exhaust 130° air so that maintenance operations would not be interrupted during the hot summer months, the five fans can all be used for exhaust, or one or more can be reversed for intake to provide spot cooling for individual areas. The value of the installation was further increased when the plant operators began using the same fans as intake units during the winter. In this application, outside air — preheated by blowing over the boiler casings — provided fresh air for the room and additional combustion air for the boilers.

A simple installation, sure. But it took a special fan to make it work—the versatile Hartzell reversible fan. Simple answers to tough industrial air-moving jobs are a Hartzell specialty. Your nearby Hartzell field engineer has the "know-how," and the equipment, to help you solve your toughest ones. Be sure to give him a call the next time you have any air-moving problem.

This installation was handled by the Hartzell field office at 4 Einhorn Road, Worchester, Mass., phone 6-2056.

HARTZELL *propeller fan co.*

Div. of Castle Hills Corp.

Dept. V

PIQUA, OHIO

ENGINEERING OFFICES IN PRINCIPAL CITIES

PROPELLER-TYPE FANS • BLOWERS
ROOF VENTILATORS • UNIT HEATERS

"Under Way On Nuclear Power"

As she blinked this terse message, the *USS Nautilus* cast off and steamed to sea leaving an old era of oceanic travel in its wake.

This is the first nuclear-powered, steam-turbine-driven submarine ever to be built. With the eyes of the world watching, it was a project with no margin for failure. Exhaustive sea trials which tested every feature of her equipment proved that the only acceptable result—success—had been completely realized.

We take pride in Walworth's share in this momentous achievement. For, from the days when the *Nautilus* was still on the drawing board to the last stage of construction, Walworth engineers worked directly with the Electric Boat Division of the General Dynamics Corporation—helping with the myriad of piping problems this new concept of transportation posed. Now the *Nautilus* prepares to join the fleet with Walworth Valves and Fittings, both standard and special items, installed.

We are glad to be aboard.

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Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

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HEAT EXCHANGERS

Now rated for many applications . . . selection made easy

Two new catalogs on B & G Type "WU" and "SU" Heat Exchangers make it a simple matter to quickly select equipment for water-to-water and steam-to-water heat transfer applications.

Ratings are given for instantaneous heating of water for service use—radiation—snow melting panels—swimming pools—boiler feed—storage tanks—and process work.

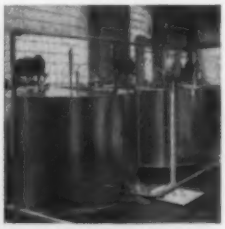
The "WU" Heat Exchanger is particularly notable for its ability to deliver a large volume of hot water from a small unit. Boiler water is pumped through the Exchanger by a B & G Booster, greatly increasing capacity and permitting close control of service water temperature. Reduction in pipe and fitting sizes and less installing labor materially cuts the original cost.

Many most commonly used sizes of "WU" and "SU" Exchangers are available from factory stock, ready for immediate shipment. Send today for your copies of "WU" Bulletin No. GC-1054 and "SU" Bulletin No. GN-1054.

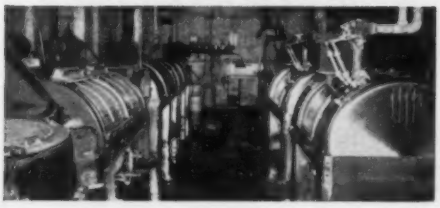
For industrial service water heating

For snow melting installations

For apartment house water heating



For process water heating



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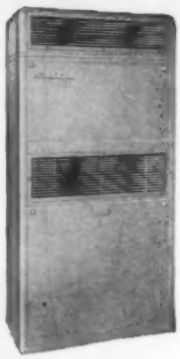
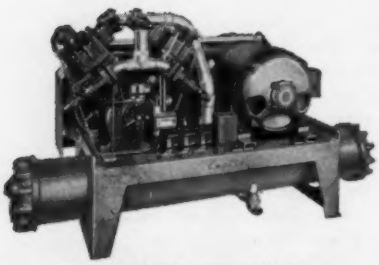


Packaged Units—2, 3, 5, 7½ and 10 tons Choice of open or semi-hermetic compressors... and 15 ton packaged Central type units



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You may qualify for a direct factory franchise. For immediate information on how to take advantage of this profit-making opportunity, write us, using your company letterhead.

National advertising in *Saturday Evening Post, Time, Newsweek* and *House and Home,* plus many other publications helps sell Curtis to your customers and prospects. Attractive new sales literature is available to help you sell in your local area.

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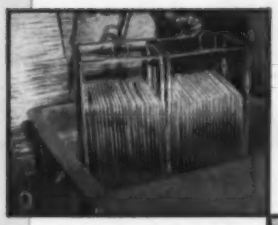
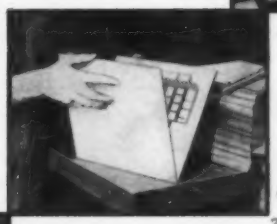
8 STEPS TO A REFRIGERATION REVOLUTION



1. Two sheets of metal are trimmed to a size which will give the proper dimensions. Plates are thoroughly cleaned before silk screen process.

2. The desired pattern is then silk screened on one of the sheets. A special stop weld ink is used to prevent bonding in pattern.



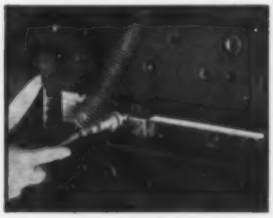
3. The next step is to weld the two sheets together to hold them during the rolling process.

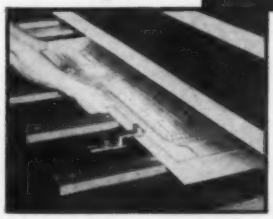
4. The union of the two pieces begins with the hot rolling. The two sheets are on the way to becoming a single homogeneous piece.

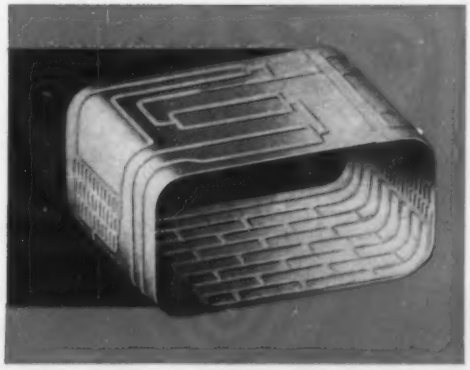
5. In the cold roll that follows, the metal reaches its final length dimension. The pattern inside the sheet is complete and ready for inflation.

6. Water pressure is then applied at the point where the stop weld material reaches the edge of the sheet. In an instant, the internal design is raised.

7. After washing and cleansing, the final step is trimming to correct size. It is then inspected for accurate dimensions.







8. Only the simplest piercing, notching and bending operations remain to be done, and the finished object is ready for final assembly.

Rolling off a production line by the thousands, leak-proof Western Roll-Bond evaporators have created a revolution in the manufacture of refrigerators. Now, a single sheet containing the entire tubing design *inside the metal itself* does the job formerly done by a maze of tubes and low conductivity welds. By using Western roll-bonding, tubing designs can be changed in a matter of days—die costs eliminated—leaks done away with forever. Other refrigerator manufacturers have changed over or are in the process of doing so—why don't you call or write today for more information on the Western roll-bonding that is setting the future pattern for an entire industry.

FREE! *Actual Sample of Western Roll-Bond Process Metal. Management, Engineering and Production men frequently ask for an actual piece of Western Roll-Bond Process Metal. Western will be happy to supply samples on request. Write to Roll-Bond Process, Metals Div., Dept. G, East Alton, Ill.*

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TRADE-MARK

metals division
OLIN MATHIESON CHEMICAL CORPORATION
EAST ALTON, ILLINOIS

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Preferred Utilities is such a source for every item from heavy oil tank heater down the line to the burner itself. It engineers and coordinates every element so as to make your heavy oil heating system work right from the start.

The Preferred Utilities line is extensive and versatile with every item an approved, quality product, truly "rigged for results."

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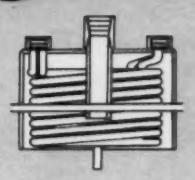
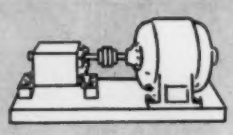
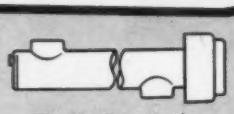
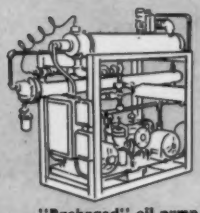

Tank suction heating coil

Ribbon heat for fuel line


Heavy oil pump


Electric oil line heater

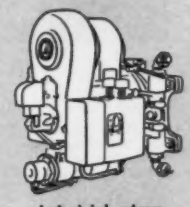

"Packaged" oil pump and heater set

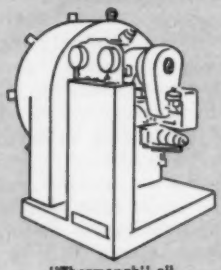
Fill box

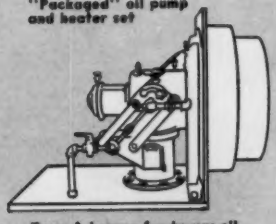
Angle check valve

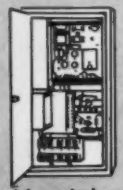
Vent protector

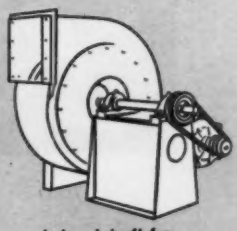
Anti-syphon valve

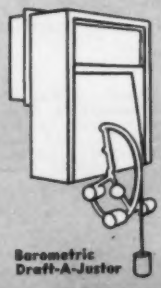

Industrial rotary burner for oil, gas or combination of fuels; oil range—7½ to 175 gph.


"Thermopak" oil or gas packaged combustion system


Type A burner for heavy oil, tar or pitch, 50 to 400 gph.


Electric control panel


Induced draft fan


Barometric Draft-A-Juster

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Oil tank gauges
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Heavy oil valves
Oil strainers
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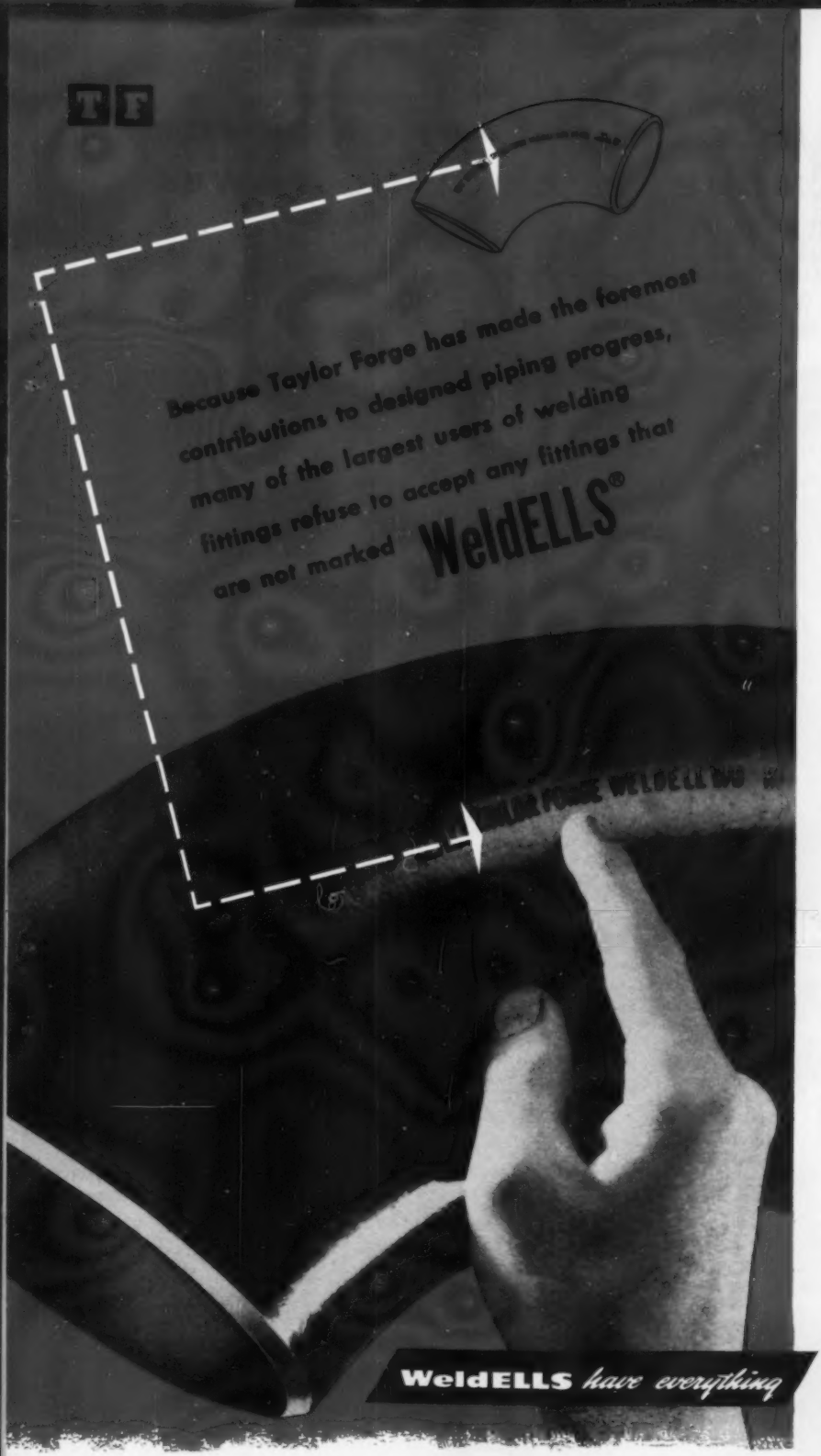
Pressure gauges
Pressure regulating valves
Tank outlet heaters
Electric immersion heaters for heavy oils
Temperature regulators
Pipe cement and joint compound
Protective refractory coatings
Condensate return systems
Observation ports
Water heaters


T F
Because Taylor Forge has made the foremost contributions to designed piping progress, many of the largest users of welding fittings refuse to accept any fittings that are not marked WeldELLS®
WeldELLS have everything

Two men got together in 1912

They had probably looked a little farther into the future of piping practice than other engineers of their time . . . these men who met in the Spring of 1912. One was the late J. Hall Taylor, founder of Taylor Forge. The other was Charles Van Stone whose name was to go into most engineering handbooks as an engineering designation.

They were relatively young men, but they were old in piping knowledge and experience. Both had watched pressures rise from the old 100 lb. level to 125 lbs., and now it was pushing 150! For these mounting pressures Charlie Van Stone had questioned threaded fittings. Seeking something better, he had worked out his method of slipping flanges over pipe ends, then flaring out the ends and facing them so that the pipe-ends would make a good gasketed seal when the flanges behind the lapped ends were tightly drawn together by bolts.

The result was a strong, leak-tight joint . . . well attested by its acceptance ever since as the "Van Stone joint." But in 1912 it had a fault that Charlie Van Stone wanted to correct. He had been forced to use cast iron flanges. When the bolts were pulled up, the cast flanges, being brittle, often cracked. Van Stone had heard that this was the same trouble Taylor had encountered and overcome by developing strong, ductile flanges of forged steel.

He had heard correctly: within a few months Taylor Forge was producing a forged steel flange that was to make the Van Stone joint equal to any pressure then or in the years ahead. In its modern version—the Taylor Forge lap joint—it is one of the most effective connections for pressure piping.

It was this meeting that marked the transition of Taylor Forge from a small forge shop making flanges for our own consumption to maintained leadership in the forged flange field. In 1912 Charles Van Stone did not know that his name would become an engineering term, and J. Hall Taylor did not know that he was shaping the course of designed piping progress.

An episode in the story of Taylor Forge leadership in designed piping

See your Taylor Forge Distributor for up-to-the-minute facts.

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The Pritchard *LOLINE* Cooling Tower is the lowest tower of 75 tons capacity and up now available. And the casing on this new tower has been carefully designed to enhance this low appearance. Corrugated asbestos cement board panels are *horizontally* installed to give low, architecturally perfect lines to the tower. Even the corners are of asbestos board and are designed to add to the attractive appearance.

FEATURES UNIQUE IN SILHOUETTE TOWER CONSTRUCTION

- New Pritchard framework design.
- Special water piping arrangement.
- New ease in installation and maintenance.
- Lower pumping head and power usage.
- New design, nail-less filling.
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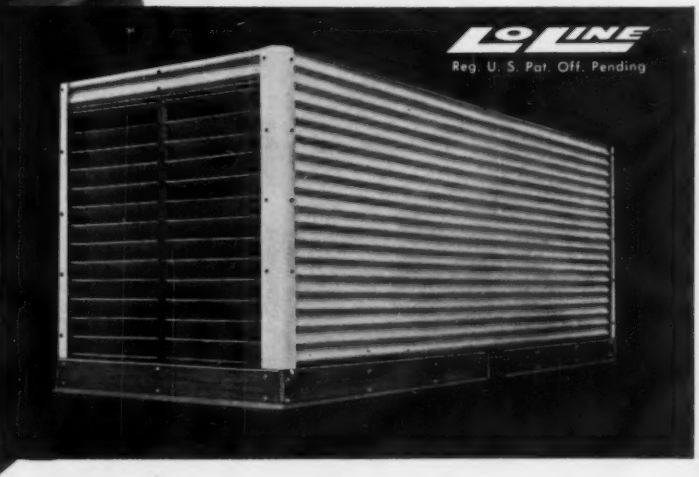
- Trouble-free mechanical equipment.

GET THE WHOLE PICTURE!

Send for your complimentary copy of the new Pritchard *LO LINE* Cooling Tower bulletin. It describes each construction feature in detail, with accompanying illustrations, capacities and specifications, cross-sectional drawing. Send for it today.



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GAS & AIR TREATING EQUIPMENT

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A DIVISION OF J. F. PRITCHARD & CO.
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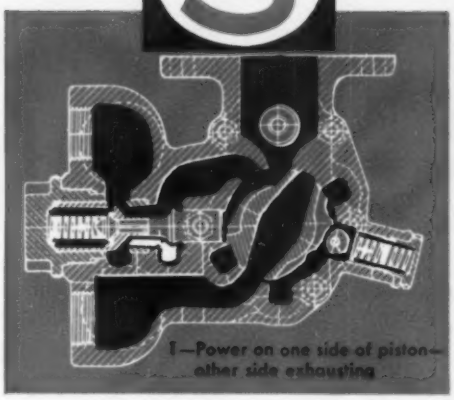
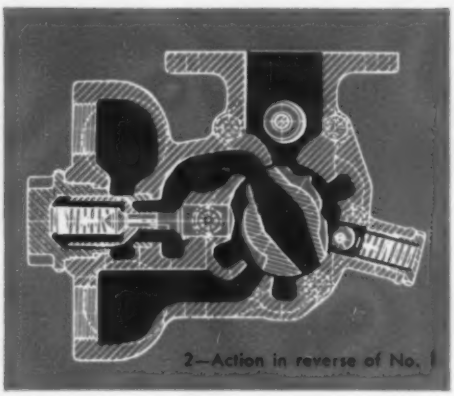
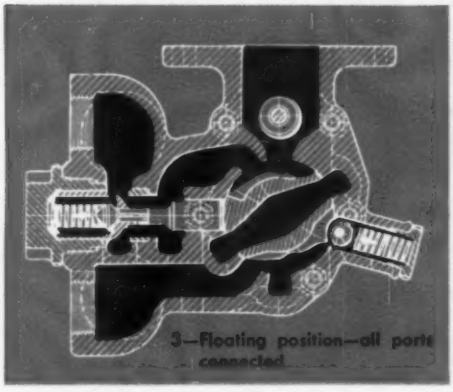
CASH STANDARD

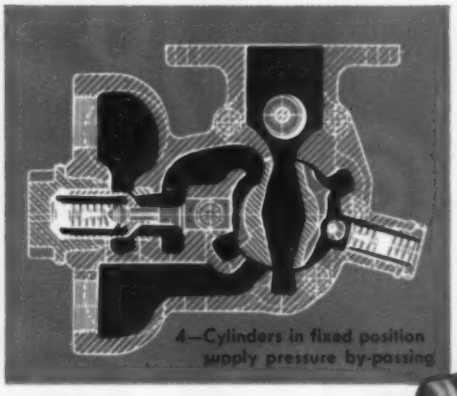
TYPE 555-RO

Four-Way Hydraulic Operating Valve









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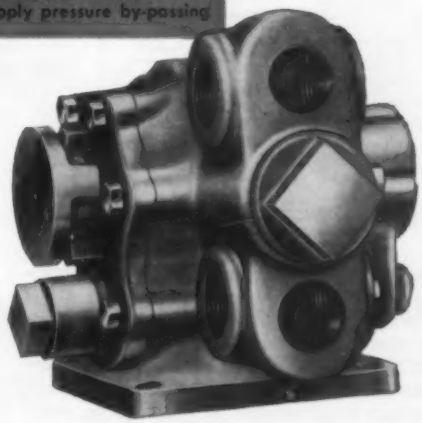


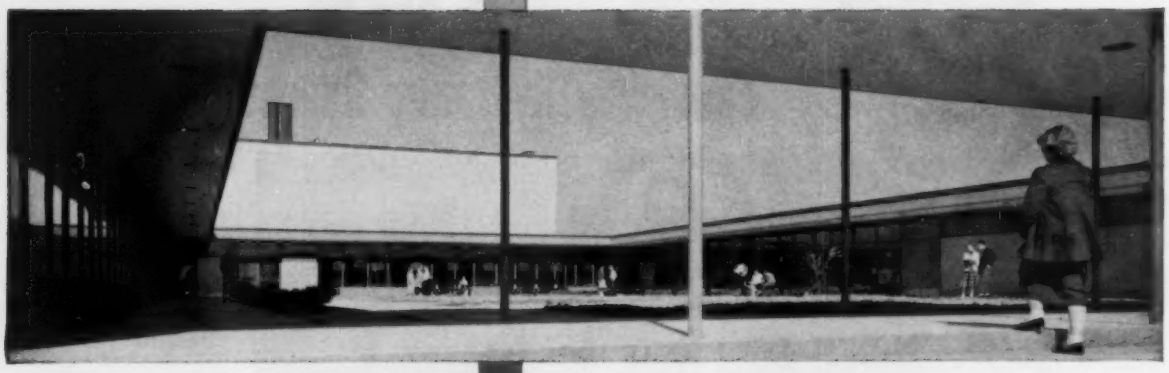
U. S. Patent No. 2360987

CASH STANDARD

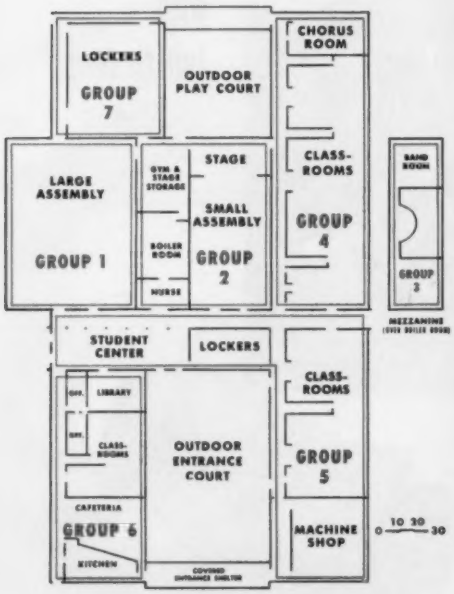
A. W. CASH COMPANY, P. O. Box 551, Decatur, Illinois

Pressure, Hydraulic, Temperature, Process and Combustion Controls

another award-winning school gains comfort . . . saves fuel with JOHNSON *DUAL* CONTROL



Norman High School, Norman, Oklahoma, recipient of First Honor Award of the American Institute of Architects in 1954. Architects and Engineers: Perkins & Will, Chicago, and Caudill-Rowlett-Scott & Associates, Oklahoma City, and Bryan, Texas. Heating Contractor: Fischer Engineering Co., Norman.



Floor plan shows how Johnson *Dual* Thermostats are grouped for convenience. During regular school hours, a *Dual* Thermostat in each room maintains every space at the ideal comfort level. When classes are over, each group of thermostats is reset, from a central point, for lower, non-occupancy temperatures. In those rooms which continue in use, a touch of the button on the *Dual* Thermostat restores them to normal occupancy temperatures, *without changing the economy settings of the other thermostats.* In a busy school, heating only the occupied rooms can easily save enough fuel dollars to pay for the cost of the entire system!

Comfort *could have been* a real problem in this remarkable school. The size of the building itself is a factor . . . so are the large glass areas . . . widely varied room sizes . . . exposure . . . changing occupancy levels. A busy program of social, athletic and other extracurricular activities is another important consideration.

But comfort *isn't* a problem, and *never will be,* thanks to a pace-setting system of Johnson Automatic Temperature Control engineered to meet the exact needs of this building and its occupants.

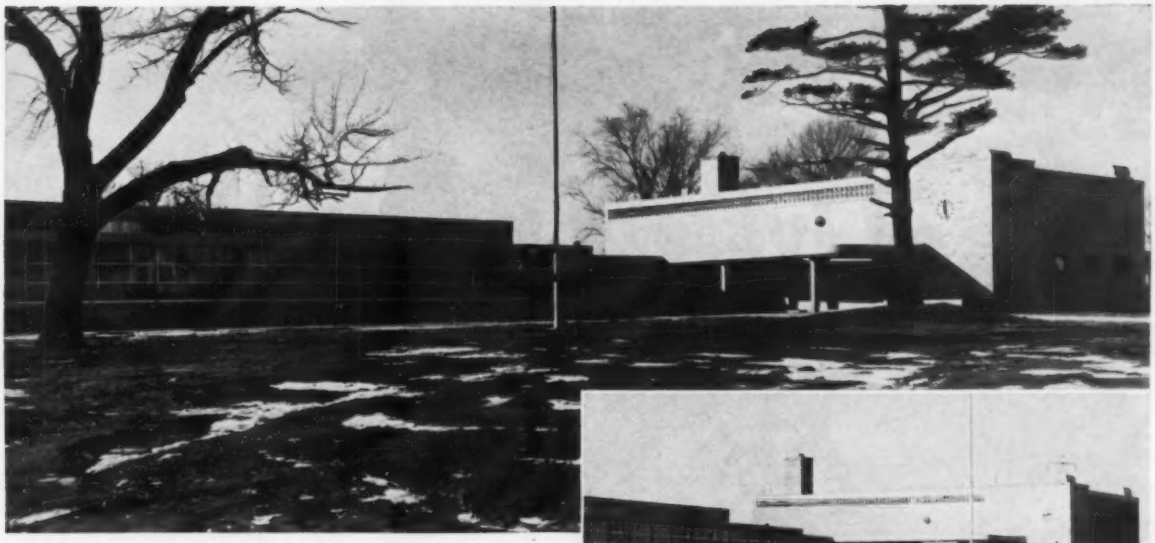
Equally important, the special economy features of Johnson *Dual* Control make it possible to provide the finest in individual room temperature regulation at a large saving in fuel costs. The accompanying plan shows how.

You can easily insure the same degree of comfort and economy for your clients' buildings that Johnson has provided for this and thousands of other outstanding buildings of all types and sizes. Remember, Johnson brings to each job over 70 years' experience in solving every conceivable type of temperature control problem—*more specialized experience than anyone else!*

Why not take advantage of this experience? A nearby Johnson engineer will gladly make recommendations for your next building without obligation. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON CONTROL
TEMPERATURE ↕ AIR CONDITIONING

PLANNING • MANUFACTURING • INSTALLING • SINCE 1885



Southport Elementary School located in southeast part of city. ▲

Wilson Elementary School located in northwest part of city. ▶

Architect: Lawrence Monberg & Associates, Kenosha, Wis.
Heating Contractor: Knab Company, Milwaukee, Wis.

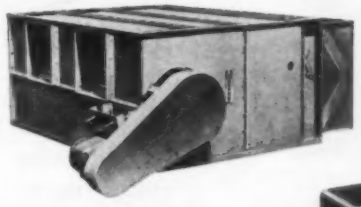
City of Kenosha Builds Twin Schools to Cut Costs... Young Heated and Ventilated

Considerable savings in architectural and equipment costs were made in Kenosha, Wisconsin, through construction of identical elementary schools in opposite sections of the city.

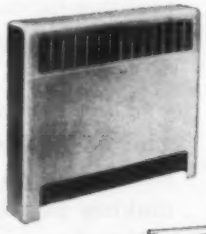
Completely modern in design and construction, these new schools are provided with *"YAC"*-30 Young Horizontal type Air Conditioning Units equipped with filters and steam heating coils which filter and temper the ventilation air, and heat the gymnasium area.

Because of the schools basementless construction, Young Cabinet Unit Heaters are mounted horizontally in crawl spaces under kindergarten room floors to maintain warm floors for the small children. And Young Convectors are used for efficient heating of meeting rooms, offices and lavatories.

For complete information on Young Heating and Cooling products, see your nearest Young representative listed in the yellow pages of your telephone directory, or write the Young Radiator Company, Dept. 515-D, Racine, Wisconsin. *"YAC" is a Young Radiator Company trademark.*



Young YAC-30 Horizontal Type Air Conditioning Unit



Young Free-Standing Convector

Young Cabinet Type Unit Heater

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Young RADIATOR COMPANY

RACINE, WISCONSIN

Creative HEAT TRANSFER ENGINEERS FOR INDUSTRY

Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

Young Radiator Company
Dept. 515-D, Racine, Wisconsin

Please send me Catalog giving detailed information data for Young "YAC" Units ☐, Convectors ☐, Cabinet Unit Heaters ☐.

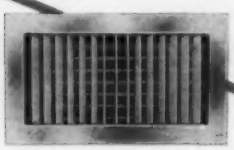
Name.....

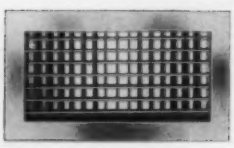
Company.....

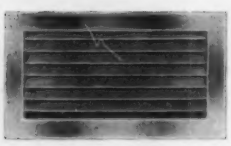
Address.....

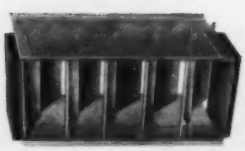
City.....State.....

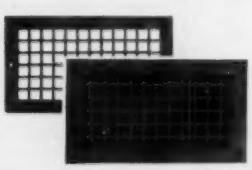
Going Over in a Big Way...











GENERAL
REGISTERS and GRILLES

As we begin our second year of manufacturing *Air Conditioning Registers & Grilles*, we are proud to count many leaders of the Industry among our representatives, their contractor customers, and approving engineers and architects.

There Must Be a Reason . . .

There is!—Never before has a manufacturer entered this field with the finest in high-production facilities, making possible consistent quality, advanced design, and volume output at competitive prices. Facilities—yes, and organization, too! Investigate the line that's *"Second to None!"*

The Complete QUALITY Line
For Cooling & Ventilating

GENERAL REGISTER
CORPORATION
14 Factory Street Cedar Grove, New Jersey

Need help
on your
Air Conditioning
problem?

The Bettmann Archive

This 16th century woodcut shows a "one manpower" air conditioning unit. From the size of that bellows, it looks as if this fellow could use some help. If you need assistance on air conditioning problems for your clients, let Airtemp help you.

Just call on AIRTEMP

Airtemp offers the help you need in planning commercial and industrial air conditioning

Get Help from Top Engineers
Through Airtemp Construction Corporation, a subsidiary of Chrysler Corporation, we offer architects, engineers and contractors the advisory service of engineering specialists—pioneers in commercial and industrial air conditioning.

Get the System You Need
Airtemp manufactures a complete range of precision-built equipment for *every* type of modern air conditioning system—conventional or specially engineered, for a room or a building.

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Everyone knows and trusts the Chrysler name. You can't go wrong on specifying a name your clients trust.

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You'll always be assured of dependable local service—thanks to Airtemp's nationwide network of personnel and facilities.

And the Cost Will Please You
Both installation cost and operating costs are surprisingly low due to Airtemp's famous design and efficiency.

WRITE FOR DETAILS
You can get complete information on this Airtemp service simply by writing to: Airtemp Division, Chrysler Corporation, Dept. HPAC-4-55, Dayton 1, Ohio.

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DIVISION OF CHRYSLER

AIRTEMP
Comfort Zone

IT'S AIRTEMP—FROM COAST TO COAST!

Union Pacific Building, Omaha, Nebr. Architect: Davis Hunt, Chicago; Engineers: Ritter & Mott, Chicago; Contractors: James Stewart & Company.

Harold Grubman Company, North Hollywood, Calif. Engineer: Sam L. Kaye, Los Angeles; Builders: Craig and Randall, Los Angeles.

Chrysler Building East, New York, N. Y. Architects: Reinhard Hofmeister & Walquist; Consulting Engineers (Structural): Edwards & Hjorth; Consulting Engineers (Mechanical and Electrical): Guy B. Panero.

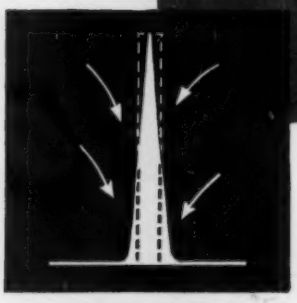
AIR CONDITIONING • HEATING FOR HOMES, BUSINESS, AND INDUSTRY

Even More Surface

per sq. ft. of face area

Even Less Air Friction

with the New AEROFIN Type B Smooth-Fin Heat Exchangers



Tapered Fin

The new smooth fin is tapered, with a wide contact base which conducts sufficient heat to make the entire fin effective transfer surface. It is no longer necessary to crimp the fin to provide the required contact area.

By eliminating the air resistance and turbulence caused by the wrinkles in the old-type coils, it is now possible to use almost twice as many fins per inch with no increase in air friction.

The resulting increase in capacity is obvious. As a consequence, these new coils offer you:

Greater capacity per square foot of face area

Lower airway resistance – less power needed to deliver the required C. F. M.

Smaller face area, due to the practical use of higher air velocities

Fewer rows of tubes for a given B.T.U. transfer in a given area

Less weight – easier handling

Better water drainage from water coils; improved venting and drainage for heating coils

Compact, sturdy design

Standardized encased units arranged for quick, economical installation

Aerofin is sold only by manufacturers of fan-system apparatus. List on request.

AEROFIN CORPORATION
SYRACUSE 1, N. Y.

1,439,000 CFM BREEZE MAKES IT A COOL COLISEUM!

Mammoth new Heart O' Texas Coliseum at Waco, Texas. Mechanical Contractor: Nuckols-Cathey and Co., Inc., Waco, Texas.

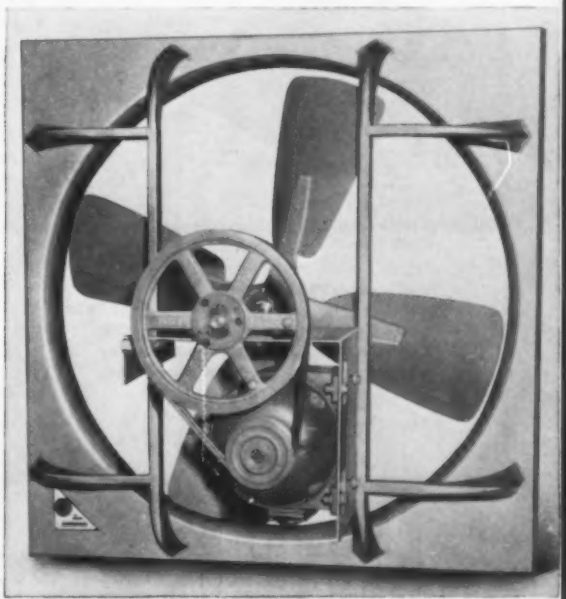
ANOTHER BIG JOB WITH "BUFFALO" — PROPELLER FANS

Note simplicity of Belt-Air installation in Coliseum roof.

We're wondering what they'll do with "Buffalo" Package Propeller Fans next! Until this widely expanded "Buffalo" line was introduced, the propeller fan was largely for "small" jobs. Now, we're shipping orders up to *sixty* units, as in this giant Heart O' Texas project — building *single fans* that will move 250,000 *cfm* for commercial and industrial uses — fans for corrosive fumes and high temperatures. Why the demand? Ease of installation and favorable first costs, of course. But efficiency and heavy-duty strength — the "Buffalo" "Q" Factor* — make these fans the choice for more and more jobs. Write for BULLETIN FM-1234 on your company letterhead, and see why!

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

Below, Design 53 Belt-Air Package Fan. Note husky die-stamped blades, panel and support arms. Proper blade shape, slow speeds mean high efficiency with low noise level. Thirty-six 54" Belt-Airs (1½ h.p.) and twenty-four 42" Belt-Airs (½ h.p.) handle the giant Heart O'Texas Coliseum ventilating job, using a total of only 66 h.p.!



"Buffalo"

BUFFALO FORGE COMPANY

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PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

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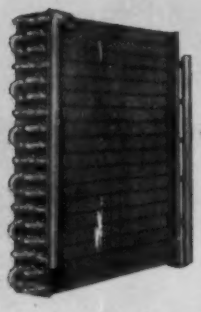
INDUSTRIAL EXHAUSTERS BELTED VENT SETS PROPELLER FANS "E" BLOWER-EXHAUSTERS

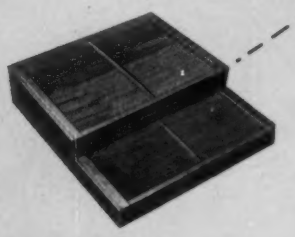
AMAZING NEW 4-WAY WATER SAVERS WITH ALL COPPER WATER SURFACES... by BUSH

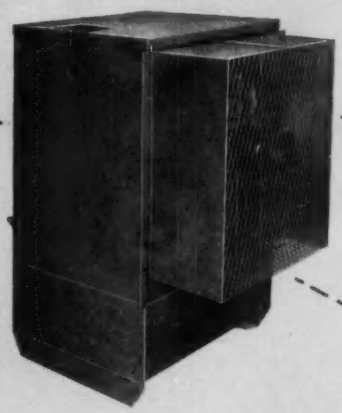


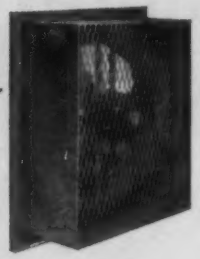
ALL COPPER EVAPORATIVE CONDENSER COIL

OR

COPPER DECK FOR COOLING TOWER







PROPELLER

OR

BLOWER FAN

YOU SELECT

Inner-Fin Evaporative Condenser Coil (All Copper) or Copper Deck Cooling Tower with Propeller Fan or Blower Fan.

You'll find **FLEXIBILITY** in these Bush Water Savers, never before available. And Bush **FLEXIBILITY** enables you to maintain a *complete* stock, without being burdened with excessive inventory. Bush standardization makes this possible.

LOOK AT THESE COMBINATION POSSIBILITIES!

A Cooling Tower (with exclusive Copper Decking) can be used with either Propeller Fan or Blower Fan.

A modern Evaporative Condenser by simply replacing the Copper Decking with Bush's exclusive Inner-Fin coil.

Cooling Tower or Evaporative Condenser, you'll be completely astounded by the *compact size.*

See for yourself and be convinced, by taking a look at your Wholesaler's or write us direct for complete catalog.

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BUSH MANUFACTURING COMPANY

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The most convincing stamp of user satisfaction

9 repeat orders for Sarco Heating Specialties

Engine factory of Caterpillar Tractor Co., Peoria, Ill. *Architects & Engineers:* Giffels & Vallet Inc., L. Rossetti Assoc., Detroit. *Heating Contractor:* The Stanley-Carter Co., Detroit.
Sarco heating specialties also are providing trouble-free service in Caterpillar's Joliet and Decatur, Ill. and York, Pa. plants.

...won by past performance at Caterpillar Tractor Co.!

SARCO heating specialties were first installed in a Caterpillar plant back in 1947.

Since that first order, Sarco heating specialties have been ordered an *additional nine times* for four Caterpillar plants — each repeat order is indicative of the confidence Caterpillar has in Sarco performance.

Today, more than 1800 Sarco steam traps in addition to other heating specialties give trouble-free service at four Caterpillar Tractor Co. plants.

Architects, engineers and heating contractors appreciate this kind of dependability. It assures them complete user satisfaction, protects reputations, eliminates trouble-some call-backs. Why not specify Sarco on *your* next job?

For full information on all Sarco products, write Sarco Co., Inc., Empire State Bldg., New York 1.

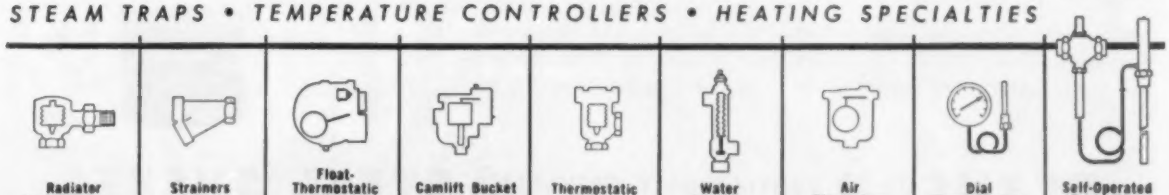
America's Industrial Leaders Repeatedly Order Sarco Heating Specialties

Aluminum Co. of America
Bethlehem Steel Co.
Caterpillar Tractor Co.
Ford Motor Company
Lederle Laboratories (Div. of American Cyanamid Co.)
United Aircraft Corporation
U. S. Steel Company
Western Electric Company

2102-B

SARCO *saves steam*

STEAM TRAPS • TEMPERATURE CONTROLLERS • HEATING SPECIALTIES



Why you can do it better with Bethcon

Bethcon galvanized sheets are the result of Bethlehem's search for a better zinc coated sheet than is possible with the ordinary hot-dip process. The Bethcon coating is applied by continuous galvanizing. Based on years of research, Bethcon sheets are a great advance over ordinary galvanized sheets, and solve many problems for sheet metal users.

TIGHTER—the Bethcon coating is more adherent and holds tighter to the steel. This means the coated sheet will take severe drawing or forming without flaking or peeling.

MORE UNIFORM—the zinc is distributed evenly over the entire Bethcon sheet. The center, the edges and the ends of each sheet get equal coating, equal protection. The heavy zinc bead usually found on the drip end of an ordinary galvanized sheet is eliminated.

BETTER LOOKING—the spangles on Bethcon sheets are bright, uniform and attractive in appearance.

You can get Bethcon sheets either in cut lengths or coiled strip, 16-gage or lighter. Either plain carbon steel or Beth-Cu-Loy (copper-bearing) steel can be used for the base metal, depending on your requirements. For further information, please get in touch with the nearest Bethlehem office.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHCON CONTINUOUSLY GALVANIZED STEEL SHEETS

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AIR FILTERS

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Continental was first to offer you "Ferris-Wheel action"—years ahead of any other filter manufacturer—to eliminate dumping filtered-out dirt back into the clean air stream.

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AND NOW . . .

Continental is first to offer you the convenience and economy of SIX-FOOT-WIDE automatic self-cleaning filter sections.

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3 GREATEST SURFACE AREA for CONVECTION HEATING
4 COMPLETELY ASSEMBLED "FACTORY UNITS"
5 FAST, EASY INSTALLATION
6 MAXIMUM RADIATION and CONVECTION PER BTU INPUT
2 HEAT CONDUCTOR PLATES are PERMANENTLY LOCKED
1 EXCLUSIVE "WRAP AROUND" HEATING PLATE DESIGN

here's why heating engineers prefer...

SHAW *panel baseboard radiators better 6 ways*

Specify... SHAW

for a perfect ratio of convection-radiant Air-e-ated heat

The men who deal in BTU's have recognized the tremendous plus-values of Shaw's engineered panel baseboard radiators. The need for rugged and efficient heating equipment in Schools, Hospitals, Churches, Factories, Offices, Ships and in the Home is fully met with Shaw's new high standard in quality heating.

Shaw's Air-e-Ated panel baseboard radiators set the pace for beauty and modern design that can readily be made to blend or harmoniously contrast with the functional decor of the modern home or office.

Let us show you how Shaw's Air-e-Ated heat can give new living comfort with the highest *quality* heat and at the lowest BTU cost input. Insist on the best . . . Shaw-Perkins for efficient long-life, beauty and versatility.

1 Exclusive "Wrap Around" heating plate design provides positive lock-contact with copper coil for maximum heat conduction . . . without weakening or prestressing coil.

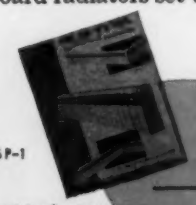
2 Heat conductor plates are permanently locked to all sides of sidewalls. This provides maximum radiation by eliminating insulating air barrier between convection plate and radiation surface. Fast, quiet heat . . . plus extreme rigidity.

3 Greatest surface area for convection heating. Conductor plates run entire height and depth of every unit and are spaced ½" apart for maximum air circulation and minimum dust matting. Each lineal foot of Shaw Unit provides over 8 square feet of heating surface.

4 Completely assembled "factory units" are all 8" high and only 3" thin. Any number of factory units are easily and quickly joined to form length desired. Straight run, inside and outside corner radiators with three tapping arrangements for right or left and opposite end supply and return piping connections . . . all join simply to provide a modern, beautiful design.

5 Fast, easy installation. Rugged factory units are easily joined into one complete radiator . . . no cutting to length . . . no parts to screw together . . . nothing to rattle. Impervious to high pressures, vibration and thermal expansion. Just screw to wall and connect supply and return ends to steam or hot water supply.

6 Maximum radiation and convection per BTU input. Rating—6.7 square feet E.D.R. average per lineal foot based on 1# steam and 65° F. inlet air. Exclusive Shaw heavy-duty construction and wide spaced, dust-proof plates, assures you of highest heating efficiency that will not change through long years of service.



SP-1

See our complete listing in Sweet's Catalog.

SHAW-PERKINS MANUFACTURING CO.

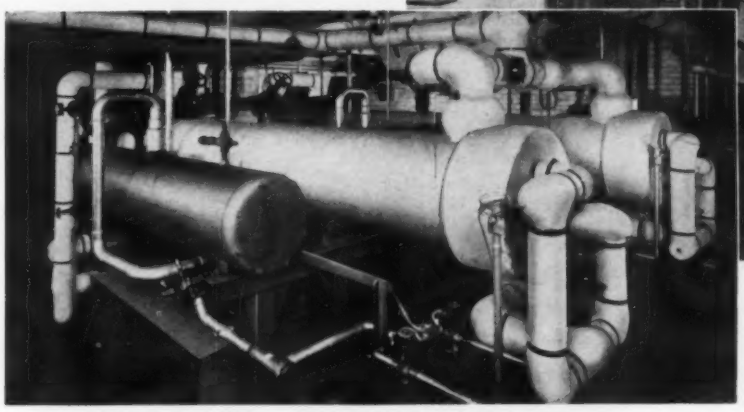
201 EAST CARSON ST., PITTSBURGH 19, PENNA.

Write for your copy of Shaw's Catalog today.

Offices in principal cities

p-k Freon Coolers

HOLD POSITIONS OF TRUST AT 12½%



National State Bank Building in Newark, New Jersey. **p-k** Freon 22 Coolers were specified by Delta Engineering and Conditioning Co., Inc., East Orange, New Jersey. "We specify them because they are the best" says William Adelman of Delta.

The air conditioning system of the National State Bank Building, Newark, New Jersey, is regarded as a sound, long-term investment in business efficiency. Initially installed to air condition ten floors of which three are now in operation, the other seven floors may be added at the bank's option *without* changes or additions to the basic refrigeration cycle.

p-k Freon Coolers are an integral part of this system. Two of these coolers provide a total capacity of 125 tons of refrigeration cooling water at the rate of 300 gpm from 52°F to 42°F. Even at 12½% total capacity, proper gas velocities are maintained for efficient operation.

Men who specify **p-k** coolers once are very likely to specify them again. **p-k** coolers were chosen for the National State Bank on the basis of previous experience. Efficient and economical, they now occupy positions of trust in countless commercial and industrial buildings.

p-k is a pioneer in the development of many types of heat exchange equipment. Whatever your heat exchange needs—heating or cooling—talk to **p-k** about them.

Write for literature or engineering help. No obligation, of course.

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101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities.

UNITS LIKE THESE...

BRING SAVINGS LIKE THESE...

* **In a New York skyscraper, Dorex Air Recovery eliminated the need for two large ducts up through 39 floors — saving valuable space as well as installation costs.**
* **In a Pittsburgh building, Dorex Air Recovery cut required air intake in half—saving some $47,000 on original equipment.**
* **In Chicago, a large industrial plant found Dorex Air Recovery so reduced required boiler capacity that over $40,000 was saved.**

BEST WAY to build your air conditioning and ventilating reputation is to offer a better installation that will save your customers money. You can do this by making Dorex Air Recovery part of your systems. The savings shown above are typical.

Dorex Air Recovery utilizes activated carbon to "manufacture" fresh air. Thus, intake of outside air can be reduced by as much as two-thirds—with corresponding savings in heating and cooling capacity.

Let us show you how Dorex can help improve your air conditioning and ventilating layouts. Write today for complete information. No obligation, of course. Connor Engineering Corp., Dept. A-45, Danbury, Conn.

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air recovery

AN AIR FILTER CURTAIN
5 Ft. Wide and
1 YEAR LONG!

ROLL-O-MATIC renewable media filter of two sections 5'0" x 8'0" high.

AAF Roll-O-MATIC OPERATES FULL YEAR ON SINGLE ROLL OF MEDIA

PICTURED above is a 5 ft. wide, 70 ft. long renewable media filter curtain for the new AAF ROLL-O-MATIC. When wrapped on a spool, this "blanket" of bonded glass fibers becomes a roll only 13" in diameter.

But here's the maintenance "miracle"! This single filter curtain, installed in a ROLL-O-MATIC section up to 11 ft. high (18,000 cfm) represents a full years supply of media under normal operating conditions. Its cost—just half that of disposable filters of equal capacity and you haven't spent that first man-hour dollar for maintenance.

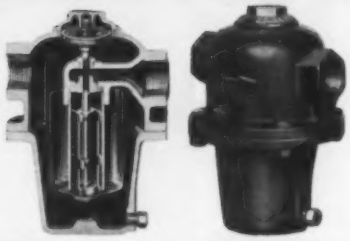
Simplicity of operation adds further to ROLL-O-MATIC's savings story. The media travels as a continuous curtain down the face of the filter and is re-rolled at the bottom. Movement of curtain to maintain desired operating resistance is controlled by an automatic time switch.

For complete information on "clean air by the roll", call your local American Air Filter representative or write for ROLL-O-MATIC Bulletin 248.

AAF herman nelson

American Air Filter
COMPANY, INC.
373 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

BETTER AIR IS OUR BUSINESS!



illinois Float and Thermostatic Traps—made in three series for operating ranges from 50 pounds pressure to 25 inches vacuum.

herman nelson Console Heaters—a complete line of heaters for commercial and institutional applications, combining smart styling with proved efficiency. Available for steam or hot water in floor, wall and ceiling models.

AAF Type W ROTO-CLONE—a dynamic precipitator which, by the addition of water sprays, extends its effectiveness to the collection of the finest, lightest dust particles. Available in 1000 to 50,000 cfm capacities.

American Air Filter Company, Inc.
373 Central Avenue, Louisville 8, Ky.

I would appreciate receiving catalogs describing the following products—

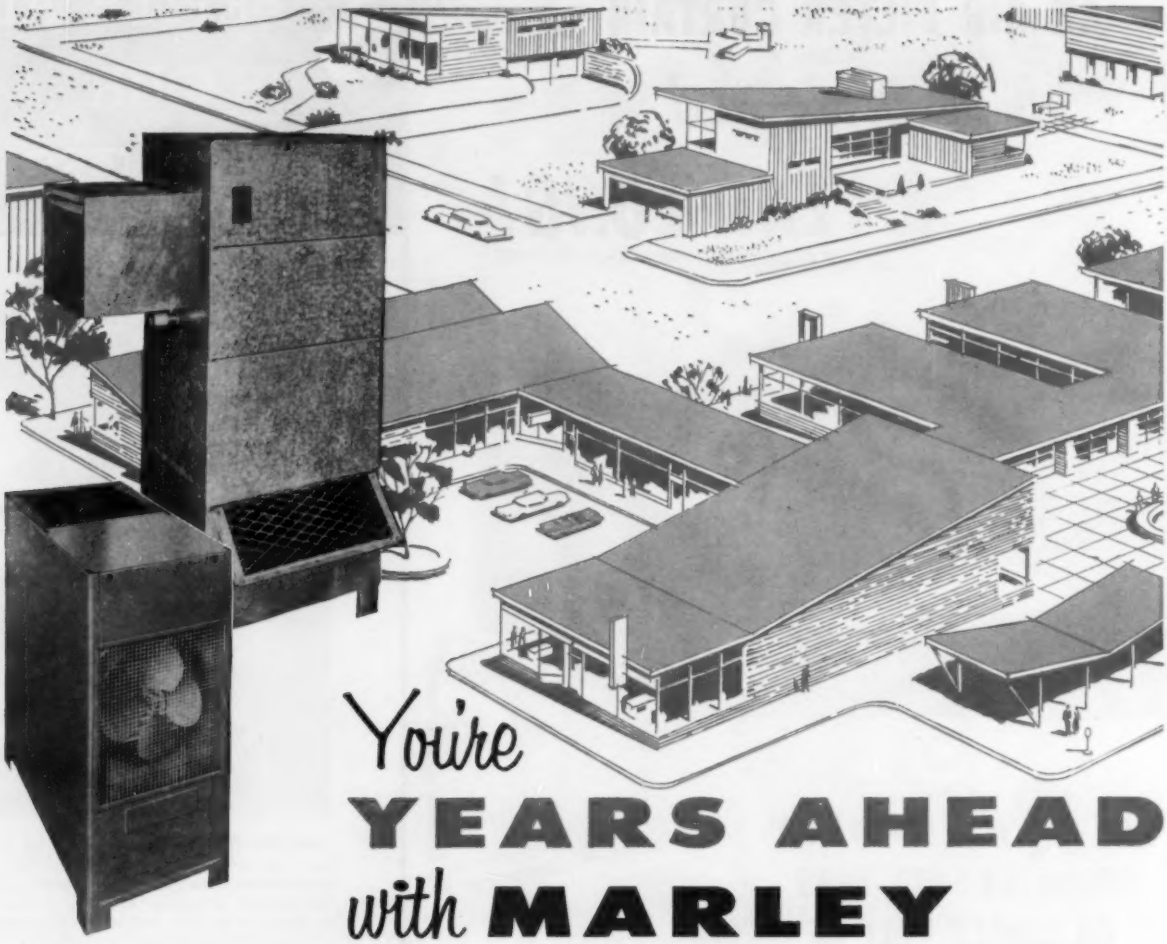
- ☐ *Roll-O-MATIC* Air Filter
- ☐ **illinois** Traps
- ☐ *herman nelson* Heating and Ventilating Units
- ☐ **ROTO-CLONE** Dust Control Units

Name_____

Company_____

Street_____

City_____ State_____



You're YEARS AHEAD with MARLEY

Want the very latest? Then there's only *one* line of packaged water cooling towers for you—and that's the '55 Marley line! Every advancement in packaged water cooling is engineered by Marley and all are incorporated in the complete line of '55 AQUATOWERS*. They're years ahead in styling. They're absolutely unmatched in performance.

1955 AQUATOWERS are compatible with surroundings wherever placed. On the ground they have the "appliance look" that home and building owners demand; on roofs or in other locations they are integral parts of the structure. There are no projecting parts; all mechanical equipment is encased and protected. Round corners improve appearance and add structural strength. The durability and performance ability that have made AQUATOWERS the world's standard are retained and enhanced in the '55 line. There is a model for every service from 2 to 60 tons.

For indoor installation where the cooling tower must operate against high external static pressure or for unusual location limitations outdoors, the Marley line includes the new AQUACOOLER*. Duct-work can be attached simply and economically to this all-galvanized counterflow tower. Its design insures its performance: all models have large centrifugal blower fans, balanced spray systems utilizing patented Marley bronze nozzles and redwood filling designed for excellent break-up of water. AQUACOOLERS are available in five sizes with capacities from 3 to 15 tons.

So if you and your customers want the maximum in *value*, don't settle for less than the latest in equipment. And Marley's '55 line *is* the latest—in fact, the "last word" in modern packaged water cooling!

"Nothing cools as well as water . . . nothing cools water as well as a Marley Tower"

MARLEY

*Trademark Reg.

The Marley Company

Kansas City 14, Missouri

The most practical way
to air-condition existing buildings!

Modine *Airditioners*

Recommended for multi-room installation in office and apartment buildings . . . hotels and motels . . . hospitals and homes

— with types and sizes for every application

CONSOLE MODEL: Superbly styled and finished . . . blends with any interior. Developed for free-standing installation, yet can be recessed so only six inches of cabinet shows.

CEILING MODEL: Deluxe unit for exposed installation on ceiling. Saves floor and wall space.

CONCEALED MODEL (front panel cutaway)**:** Designed for easy, out-of-sight installation in the wall.

OVERHEAD MODEL: Available with or without plenum and filters for use in furred overhead space.

• Are you faced with the problem of air conditioning existing buildings? Investigate the Modine AIRditioner*—equally suitable for new construction and modernization work. AIRditioners save the cost of installing duct systems. Choice of 4 distinct types helps you avoid structural alterations. Frequently used to replace radiators where year 'round comfort is desired.

Cold water from a central chiller or other source is piped to each unit for summer cooling. Heating is accomplished with hot water from a central source. The same piping—water supply and return and drain—serves each unit for both cooling and heating. Yet AIRditioners are individually controllable!

For facts, call the Modine representative listed in your classified phone book, or mail the coupon today.

**Trademark*

MODINE MFG. CO.
1509 DeKoven Avenue, Racine, Wisconsin

Gentlemen: Please send me a free copy of Bulletin 754-D, describing Modine AIRditioners.

Name .....

Firm .....

Address .....

City ..... Zone ..... State .....

A-1255

IN MANUFACTURING PLANTS...

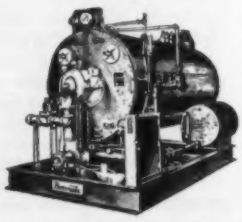
Powermasters SAVE from Start to Steam!

FOR EXAMPLE: A $10,000 annual saving was made possible when this battery of four 80 hp. *Powermaster* Packaged Automatic Boilers replaced a 200 hp. coal-fired boiler in a large Mid-West plant of a prominent electrical manufacturer. The *Powermasters* eliminated a smoke nuisance . . . coal and ash handling . . . and labor costs for firemen. Improved steam pressure and quality, and operating flexibility were other advantages gained.

Savings start with *Powermaster's* simplified installation whether single or multiple units. No special foundation or costly stack is needed. As delivered, *Powermasters* are fully equipped, completely wired and factory fire-tested for fast operation as soon as fuel, water, electrical and steam connections are made. Other cost-saving advantages are high fuel economy at all loads, space-saving compactness, dependability, maintenance-saving accessibility, fully automatic operating and safety controls, smokeless combustion and hospital-clean boiler room.

Check *Powermaster* feature by feature, and see why satisfied users all over the U.S.A. agree that "Steam Costs Go Down Where *Powermasters* Go In." Send for latest bulletin describing and illustrating all the *Powermaster* cost-saving features.

O&S *Powermaster*®
PACKAGED AUTOMATIC BOILERS
In sizes to 500 HP; pressures to 250 psi.



ORR & SEMBOWER, INC.
Established 1885 • Morgantown Road, Reading, Penna.

STAINLESS STEEL

...fights corrosion...solves many piping problems

● Stainless steel piping, using TUBE-TURN* Stainless Steel Welding Fittings, can provide long, safe service where corrosive gases or fluids are handled. Likewise, stainless steel systems are superior where temperature extremes are encountered, for handling dangerous materials safely, for preventing contamination.

Tube Turns offers a *complete line* of Stainless Steel Welding Fittings in three analyses: AISI Type 304, Type 347, and Type 316; and in four schedules: 5S and 10S (thin wall), and 40S and 80S (heavy wall). For the *right* stainless steel welding fittings, and for help in proper application, get in touch with your Tube Turns' Distributor. You'll find one in every principal city.

TUBE-TURN Welding Fittings and Flanges are made in U.S.A.
They meet all U.S. piping code specifications

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • Chicago • Denver • Los Angeles
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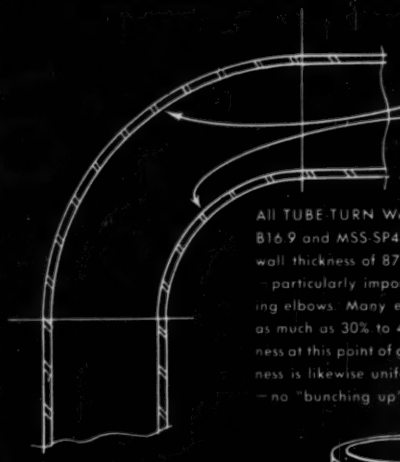
*"tt" and "TUBE-TURN" Reg. U.S. Pat. Off.

STAINLESS DATA

How you get *extra service* from TUBE-TURN* Stainless Steel Welding Fittings

EXTRA-VALUE FEATURES AT NO EXTRA COST

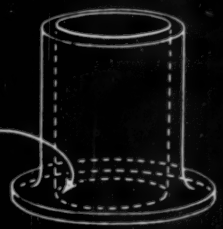


UNIFORM WALL ASSURES UNIFORM STRENGTH

All TUBE-TURN Welding Elbows meet ASA B16.9 and MSS-SP43 Standards on minimum wall thickness of 87½% of nominal thickness — particularly important on thin wall welding elbows. Many elbows on the market are as much as 30% to 40% below nominal thickness at this point of greatest wear. Wall thickness is likewise uniform on the inside radius — no "bunching up" of metal.

MATCHES PIPE BURSTING STRENGTH

Welding Tees are adequately reinforced. Along with other TUBE-TURN Welding Fittings their strength matches the calculated bursting strength of the pipe.



NO CORROSION POCKETS

TUBE-TURN Lap Joint Stub Ends have a square inside corner (which eliminates a "corrosion pocket") and a proper fillet radius (which assures strength under flexing and vibration).

CHECK THESE FEATURES

Only TUBE TURNS offers them all

- Fittings meet standard chemistry specifications
- Minimum wall thickness of elbows 87½% of nominal
- Fittings meet minimum calculated bursting pressure of matching pipe
- Qualified welders and procedures used where welding is required
- Each fitting properly solution heat treated
- Each fitting passivated
- Other special grades of stainless steel, and all other alloys available

All these extra value features available to you at no extra cost.

MEET ALL CODES

TUBE-TURN Stainless Steel Welding Fittings meet all specifications: ASTM A312 (for material); MSS SP43 and ASA B16.9 (for dimensions); and MSS SP25 (marking procedure).

IMPORTANT DATA . . .

"Stainless Steel Piping . . . Why and Where to Use It"—Advantages of stainless steel, types, selection of pipe joints; sanitary requirements, avoidance of contamination, welding, heat treatment, etc. Mail coupon for free book.

TUBE TURNS, Dept. A-2
224 East Broadway, Louisville 1, Kentucky
Please send STAINLESS STEEL "WHY AND WHERE" book.

Company Name _____

Company Address _____

City _____ *Zone* _____ *State* _____

Your Name _____

Position _____

DISTRICT OFFICES

New York	Los Angeles
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Detroit	Houston
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* "tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

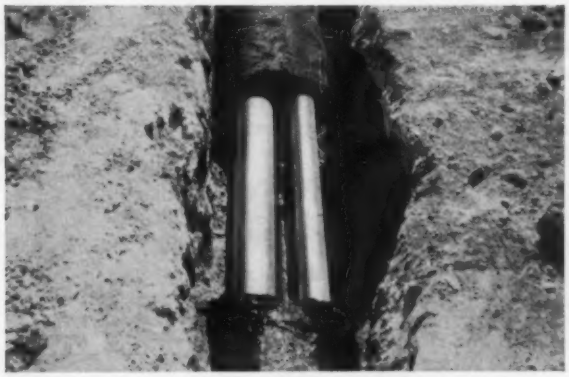
TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY
LOUISVILLE 1, KENTUCKY

3 Big Reasons Why

1. GILSULATE—Easy to install—Just pour it on, tamp it down and backfill. Run heat through the pipes (up to 520°F)...and the job is completed. No need to remove rocks from backfill; no problems of cramped space or multiple piping.

more and more hot underground pipe gets insulated



2. GILSULATE—Cost Less per Installed Linear Foot—No skilled labor needed...requires no mechanical sheaths, special protective devices, or costly installation procedures.

with new modern triple-zone GILSULATE®

ZONE 1 Dense, semi-plastic coating bonded tightly to pipe surface. This Zone is waterproof and a thermal and electrical insulator.
ZONE 2 Sintered zone provides excellent thermal insulation under wet or dry conditions. Zone 2 is also waterproof.
ZONE 3 Unconsolidated GILSULATE particles provide excellent thermal insulation and a high load carrying capacity.
PIPE WALL

3. GILSULATE—Delivers Permanent Triple-Zone Protection—Three tough, massive circular sheaths completely and permanently protect the pipe, cut heat loss down to 8% to 11% of bare buried pipe. Triple-zone protects against all buried line corrosion conditions: water, roots, acid, alkalis, bacteria, etc.

Fill in coupon for complete details.

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES

AMERICAN GILSONITE COMPANY, SALT LAKE CITY, UTAH
Affiliate of Barber Oil Corporation and Standard Oil Company of California
Distributors in principal cities of United States and Canada

American Gilsonite Company
134-B West Broadway
Salt Lake City, Utah

Please send me further information on GILSULATE

NAME.....

TITLE.....

COMPANY.....

ADDRESS.....

HPA

NEVER Ventilate a Ceiling or Wall Space to the Inside...

If you do, the better the insulation, the worse will be the condensation; for the colder the air in the space between insulation and roof or walls, the less vapor can it support in suspension.

In new construction, moisture is evaporating from many tons of cement and plaster. Vapor flows from areas of greater density into this small, cold space, an area of less vapor density and small vapor capacity.

Where multiple accordion aluminum is used, fortuitous vapor and water (for instance rain) will gradually flow out, as vapor, through exterior walls and roofs as vapor pressure develops within. The vapor cannot back up through the continuous, almost impervious aluminum. It will flow out because walls and roofs have substantial permeability by comparison, far greater than the required 5:1 ratio. Infiltration under the flat stapled flanges of multiple accordion aluminum is slight.

Unusual amounts of vapor, as from crowds in theatres, churches, schools, stores, etc. must be adequately vented to the outside. Each person breathes out and perspires vapor, winter and summer, at the rate of 3 lbs. a day.

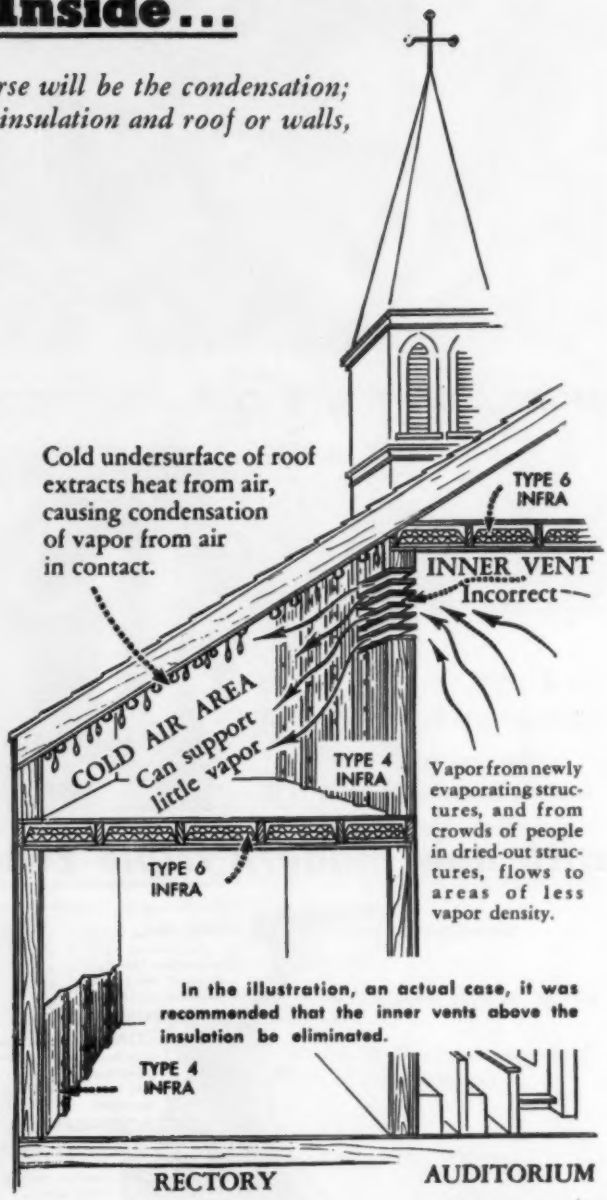
To obtain MAXIMUM, **uniform-depth** protection against heat loss and condensation formation, it is necessary to use the new **edge-to-edge** multiple aluminum*, **each** sheet of which stretches from joist to joist, and also all through the flanges for further vapor protection as well as permanent attachment of each sheet.

The U.S. National Bureau of Standards has prepared a helpful and informative booklet, "Moisture Condensation in Building Walls" which discusses causes and cures. Use the coupon and we will send a free copy.

*Patent applied for

COST OF EDGE-TO-EDGE INFRA
Multiple Aluminum Insulation
installed in new construction between wood joists, material and labor
Type 6-S under 9½¢ sq. ft. Type 4-S under 7½¢ sq. ft.

INFRA INSULATION, INC., 525 Bway., New York, N. Y.


Cold undersurface of roof extracts heat from air, causing condensation of vapor from air in contact.
TYPE 6 INFRA
INNER VENT Incorrect
COLD AIR AREA Can support little vapor
TYPE 4 INFRA
Vapor from newly evaporating structures, and from crowds of people in dried-out structures, flows to areas of less vapor density.
TYPE 6 INFRA
In the illustration, an actual case, it was recommended that the inner vents above the insulation be eliminated.
TYPE 4 INFRA
RECTORY
AUDITORIUM

INFRA INSULATION INC.
525 Broadway, N.Y.C., Dept. H-4

☐ Please send FREE U.S. Bureau of Standards Booklet BMS63 ☐ Please send samples

Name_____

Firm_____

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THE EDITORS' PAGES

• *THE SHORTAGE OF CLASSROOMS continues, and according to reports, the future outlook does not seem to be bright, in spite of President Eisenhower's proposed $7 billion aid program for schools. Enrollments in public elementary schools by 1958 may reach 26 million, or 4 million above the number now in school. Perhaps full year school terms in some cities might be a solution, which would undoubtedly require air conditioning in many cases . . . . In a recent architectural contest for planning Chicago's future, sponsored by Carson, Pirie, Scott & Co., a leading department store, one proposal involved a structure four square blocks in size. It would be a glass and steel canopy enclosed shopping center with a constant temperature of 72 F. Wonder when it will be ready? . . . . . We note with interest that one group of engineers has organized a class of "verbiage pruners" among its letter writers. Students are urged to organize their thoughts before dictating. Then, to talk clearly, using simple, clear words and short sentences* — 21 *to 30 words.*

Construction Awards Continue High Records

. . . latest figures show

CONTRACT AWARD totals released last month for future construction in the 37 states east of the Rockies reveal new high records, according to the F. W. Dodge Corp. February's total was the highest for any February on record, and the January-February total likewise was the highest ever for the two months. February's $1,581,143,000 was up 29 percent over February 1954 and 5 percent ahead of last January. The two-month total of $3,085,593,000 was up 30 percent over 1954.

Both non-residential and residential totals were the highest in any February, with residential being the stronger. February totals were: non-residential, $534,463,000, down 5 percent from January but up 14 percent over February 1954; residential, $744,102,000, up 8 percent over January and up 46 percent above February 1954; heavy engineering, $302,578,000, up 21 percent over January and up 24 percent over February 1954.

1000 Tons of Sulfur To Be Recovered Daily from Air

. . . say air pollution experts

A THOUSAND tons of sulfur daily will be recovered from the air by petroleum refineries by the end of 1955. Los Angeles refineries are recovering 360 tons of sulfur daily. Houston, 120 tons. And Philadelphia expects to recover soon 165 tons a day.

These are among the facts presented to the First International Congress on Air Pollution, held recently in New York, by G. E. Smalley and James W. Klohr of the Ralph M. Parsons Co., of Los Angeles. In summary, the process is a controlled combustion in which one-third of the hydrogen sulfide is burned to form sulfur dioxide, which reacts with the remaining two-thirds of the hydrogen sulfide to form sulfur and water vapor. The recovered sulfur will represent a reduction of about 2000 tons a day of sulfur dioxide that is normally released to the atmosphere.

The congress, the first of its kind and attended by delegates from seven countries, was sponsored by The American Society of Mechanical Engineers as a feature of its 75th anniversary.

"Quote"

"The potential market for air conditioning is so broad that apparently there is no way of accurately measuring it. So long as general business is strong, the problem will be to keep pace with demand."—*D. C. Minard, president, The Trane Co., in a recent statement.*

"Snow Won't Lie and Grass Won't Grow"

. . . legend has explanation

BETWEEN THE OLD JAIL and the courthouse in Charles Town, Jefferson County, W. Va., is a path across which John Brown — American abolitionist of the early 1800's — walked daily. According to local legend, "the snow won't lie and the grass won't grow where his steps have fallen."

J. W. Kreuttner — of Buensod-Stacey, Inc., air conditioning contractors — told us this the other day. It's true, too, he says — but not as mysterious as it sounds. It seems there is a path between the two buildings and traffic prevents the growth of grass. Under the path a heating line from the courthouse boiler plant is imbedded which loses enough heat to melt any snow that falls. The rest of the story is, that the shortest distance between the two buildings is a straight line — therefore, the coincidence of path and pipe.

21 Patents Released for Public Use by the AEC

. . . copies are available

DESCRIPTIONS of 21 patents owned by the government and held by the Atomic Energy Commission have been released by the commission.

The AEC will grant nonexclusive, royalty-free licenses on the listed patents, as part of its program to make nonsecret technological information available for use by industry. Commission-held patents and patent ap-

plications released for licensing now total 747.

Among the patents released is No. 2,691,481 for a vacuum pumping apparatus for the production of high vacuum of the vapor stream type. Size limitations of the prior art devices are overcome, enabling the production of higher vacuum with fewer pumping systems. One or more rectangular openings of the chamber to be evacuated communicate in tapered configuration to a substantially rectangular discharge opening maintained under reduced pressure by mechanical pumps. The higher vacuum is obtained by a fast moving, continuously recycled, vapor stream introduced from boilers through elongated tubular vapor jets disposed in spaced relation longitudinally of the discharge path.

Another patent, No. 2,691,773, is for a valve leak detector for fluids at above atmospheric pressure. The detector replaces the conventional packing glands with a positive type seal. This is accomplished by designing the valve to be seated by rotating a nut rigidly attached to the valve handwheel, which moves a shaft into its seat to close the valve. The seal is provided by two flexible bellows, one within the other, with their ends attached to the moving shaft and its stationary housing, respectively. Indicating means are provided to detect failure of either of the bellows.

Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title. Copies of those patents may be obtained from the U.S. Patent Office.

Air Conditioning To Be Standard for Offices

. . . an important application

AIR CONDITIONING will be considered a "standard requirement" of offices within the next 10 years, according to the National Office Management Association. The prediction is based on "the proved productivity increases" with the installation of air conditioning.

Offices represent a most important application for air conditioning. At the annual convention of the Heating, Piping and Air Conditioning Contractors National Association, W. S. Bodinus, chairman of the HPACCNA's air conditioning committee, said that "office buildings represent about 30 percent of the total business in the large building field of air conditioning."

DESIGNED AROUND YEAR 'ROUND AIR CONDITIONING, the new $4 million New York State office building at Syracuse is "conservatively modern," with abundant sun-resistant glass areas

New State Office Building Air Conditioned

THE NEW $4 million state office building in Syracuse, N. Y. is only the second New York State office building to include air conditioning at the time of construction. It will contain 125,000 sq ft of office space and is expected to be ready for occupancy by September 1, 1956, according to the Carrier Corp.

The main building will be 135 ft tall, and an 80-ft long entrance wing the full height of the building will form the stem of an abbreviated "T".

To take advantage of the many benefits of air conditioning, the building has been specifically designed for and around it. For instance, heat absorbent glass is to be used, which reduces possible solar heat gain by as much as 15 percent over ordinary glass.

Approximately 95 percent of the water used in the condensing coils of the refrigeration system will be saved by installation of a rooftop cooling tower.

Chilled water for cooling will be supplied by two centrifugal compressors in the basement. The total cooling capacity of these machines will be 600 tons. A common piping system will supply the system and 10 air handling units serving the interior zones with either chilled or warm water for both summer and winter air conditioning.

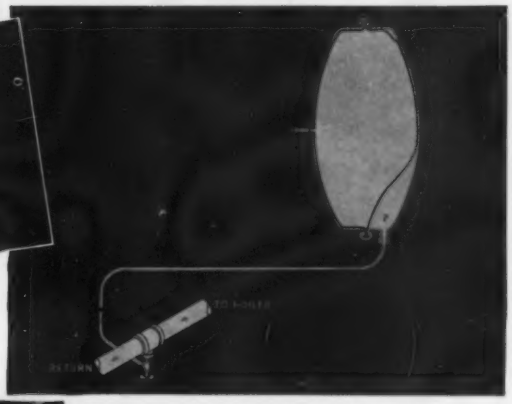
Three central air stations in one penthouse will supply conditioned air to the units furred into the wall underneath windows so as to take up no useable space. A mixture of outside and inside air will be conditioned by eight central system air conditioning units for serving interior areas away from outside walls. One unit will be located on each floor next to the elevator shafts. The spacious hearing aid room on the first floor and the court room on the eighth floor will be individually served by two more of these units.

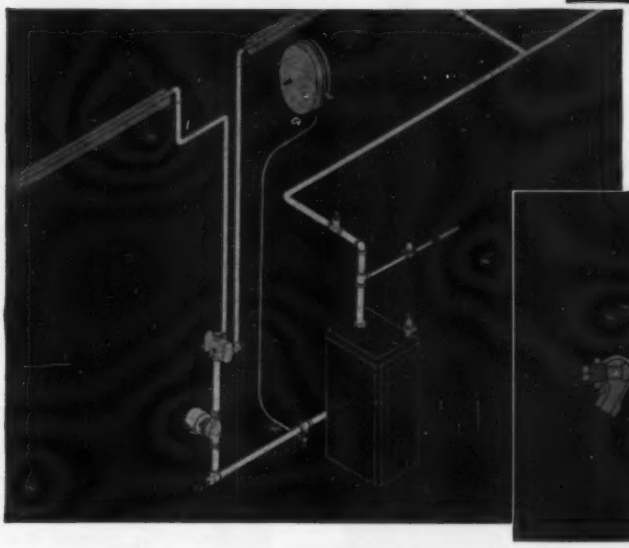
All air will be distributed at high velocities through small ducts and conduit risers fitting along the steel girders in the outside wall space.

All architectural and consulting engineering work has been performed by C. J. White. Kenneth A. Taylor, Inc. is the mechanical contractor.

Webster Baseboard Heating is first again

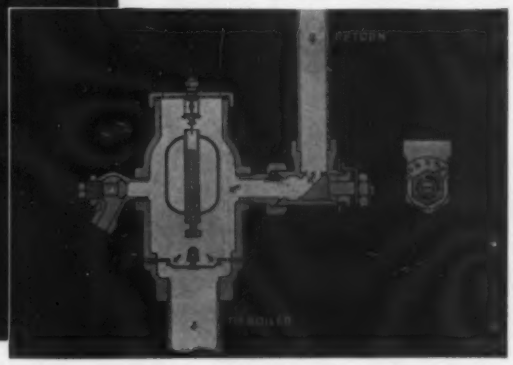
with NEW HYDRO-HEAT features





Arrangement of Tru-Perimeter Forced Hot Water Webster Baseboard Heating with new Hydro-Heat features, at left. Water Accumulator, above, takes care of expansion and water pressure variations.

Sectional view of new Webster Purge Header, below. Made in two models, providing for one to six Tru-Perimeter loops.



The First No-Air All-Hydraulic Hot Water Heating System

Webster Baseboard Heating — first to use the Tru-Perimeter principle to assure comfort heating — is now further improved with new Hydro-Heat features. Result is greater simplicity, greater freedom from servicing, and quieter heating than ever.

Key to Hydro-Heat's trouble-free, noise-free operation is the new Hydro-Heat Water Accumulator, replacing the expansion tank. Since surface contact between water and air is eliminated, there is no re-absorption of air into the all-hydraulic system. Installation is easy . . . just hang it from the joists, connect the tubing and open the valve.

The new, improved Webster Purge Header, a matching component of Hydro-Heat installations, has only one purge valve, instead of a separate valve for each circuit. New Balance Valves are sturdy and easy to use. Inside there is a new heavy-duty float-operated vent.

Other proven Webster Hot Water Heating Specialties include Pressure Relief Valves, simplified Pressure Regulating Valves, Webster Flow Valves, and Webster Tru-Perimeter Expansion Joints.

For more detailed information about Webster Baseboard Heating with new Hydro-Heat features and proven Webster Hot Water Heating Specialties, see your Webster Representative or write us.

Address Dept. HP-4

WARREN WEBSTER & COMPANY

Camden 5, N. J., Representatives in Principal U. S. Cities

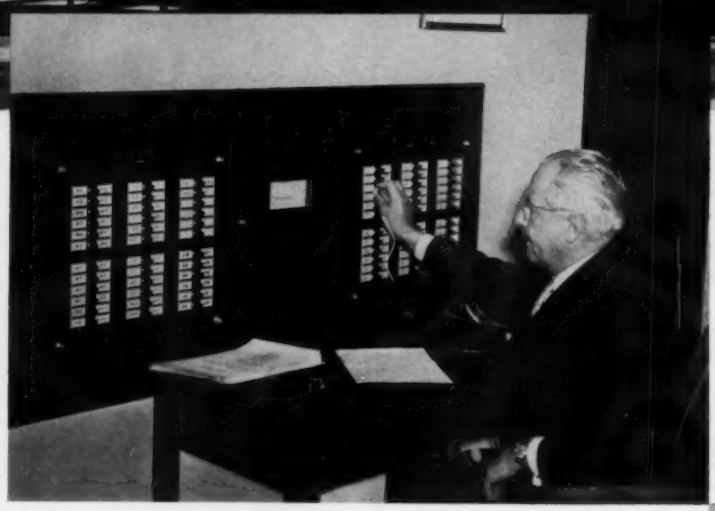
In Canada, Darling Brothers, Limited, Montreal

Webster

TRU-PERIMETER FORCED HOT WATER BASEBOARD HEATING

AND

Webster Heating Equipment includes Webster Walvector also used in Tru-Perimeter Heating; Convectors; Steam Heating Specialties for heating and process applications; Webster Moderator Systems of Steam Heating and continuous flow controls for hot water heating — both with outdoor thermostat; Unit Heaters. Data on request.



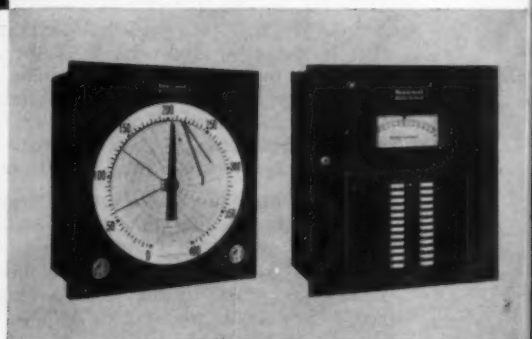
FAHRENHEIT AT FINGERTIPS

144 different temperatures at scattered locations throughout the home office building of Mutual of Omaha and United of Omaha in Omaha, Nebraska, can be checked at the pressing of a button by means of multi-point *ElectroniK* Precision Indicator. The building's mechanical engineering superintendent can get the temperature data he needs quickly and accurately, without moving from the central control panel.

• FOR MEASURING AND CONTROLLING

steam heating coils
reheat coils
sequenced heating and cooling coils
primary air supply systems
chilled water temperatures
space, air, liquid and steam temperatures
differential pressures
air conditioning loads
. . . and many others

• BROWN INSTRUMENTATION INCLUDES . . .



ElectroniK *temperature recorders and controllers*

ElectroniK *multi-point Precision Indicators*

For your air handling system's central control–

it pays to specify ***Brown Instruments***

THE CONTROL centers of your building's air handling system can give you the full benefits of increased efficiency, simplified supervision and peak performance when you utilize Brown recording and controlling instruments.

The ideal companions for Honeywell air-conditioning controls, Brown instruments encompass a diversified line. They cover literally any variable that can be encountered in a complex system . . . temperature, pressure, flow and humidity.

You get plus values in performance. Brown instruments are famous for their ability to deliver high quality, trouble-free service that results in maximum operating economies, power savings and maintenance of comfort. They're the leading choice of industry for process control applications . . . and they've been selected for many major air handling installations.

You get plus values in engineering. Made by the Brown Instruments Division of Honeywell, the world's largest producer of controls, these instruments are backed by extensive know-how in the air handling field. They are custom-fitted to the individual job by men who are thoroughly familiar with the equipment, processes and specifications peculiar to this type of application.

You get a single responsibility for control. Only Honeywell, with its complete family of instruments and controls, can give you the advantage of a single source for all control equipment for the entire air-handling installation.

Your local Honeywell salesman will be glad to discuss how Brown instruments can fit into your system's control center. Call him today . . . he's as near as your phone.

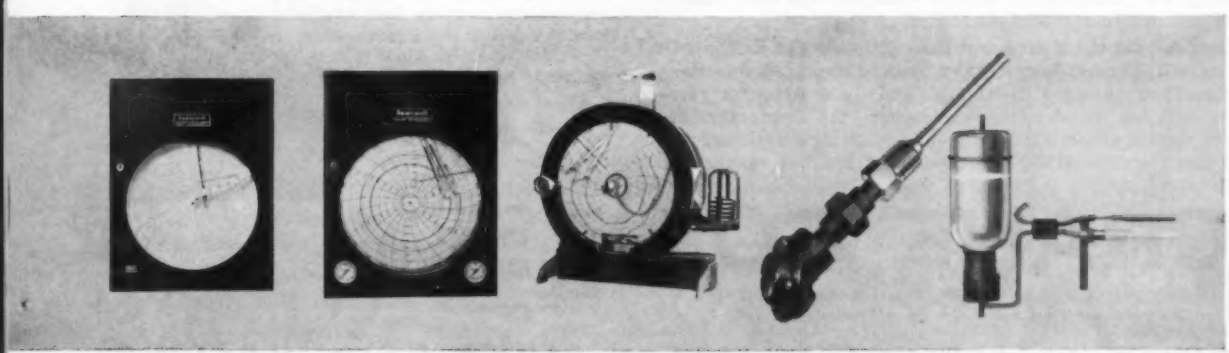
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

● **REFERENCE DATA:** Write for new Catalog SA 1810 A.



Brown Flow Meters . . . indicating, recording, controlling, integrating

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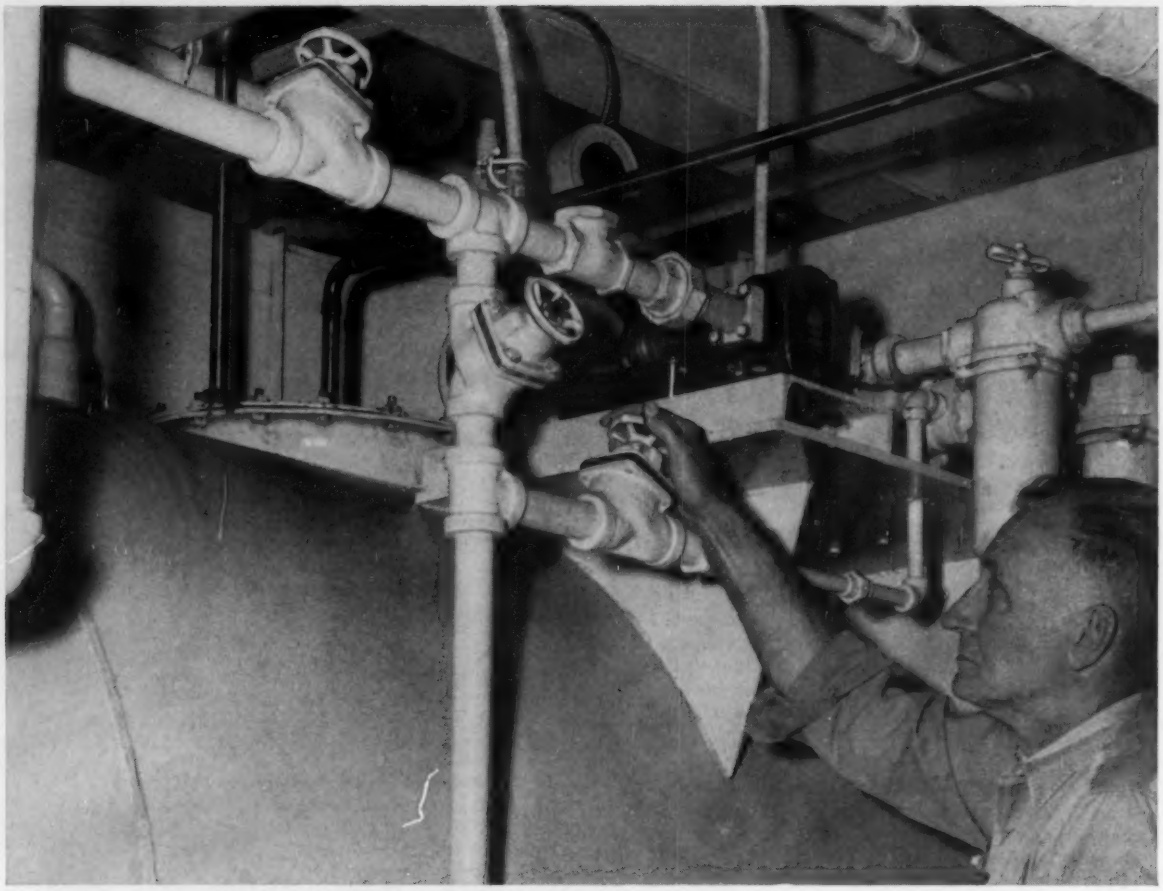

Light oil meets its master in these CRANE VALVES

THE CASE HISTORY— Read how the Johnson & Johnson baby products plant at Cranford, N.J., completely stopped a valve leakage condition that wasted product . . . caused a safety hazard . . . and menaced the plant's high sanitation standards.

Valves formerly used on very light baby oil lines were the source of trouble. Keeping them tight at the stuffing box was next to impossible. Constant servicing of stuffing boxes was necessary, even after repacking every 4 to 8 weeks. Several packings were tried without success while the high maintenance costs and nuisance conditions continued.

Early in 1951 the plant found the solution in Crane No. 1610 Packless Diaphragm Valves. They removed the cause of leakage —immediately stopped its troubles and costs. Almost 4 years later—with no maintenance whatsoever—the Crane packless valves remain absolutely tight; continue giving perfect service. And that goes for all valves added since the first installation.

Crane No. 1610 Packless Diaphragm Valves

When you have valve problems with hard-to-hold fluids, try Crane *Packless* diaphragm valves. They eliminate stem leakage and maintenance on air, vacuum, gas, light oil and similar services. Their diaphragm has longer life, yet should it fail, their separate disc prevents escape of line fluid. Available in wide selection of materials and sizes. Ask for folder AD-1942 or see your Crane Representative.

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"OPEN FOR DISCUSSION"

• *WE FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

Elbow Loss Test Results Differ According to Test Method

THE ARTICLE, *How Much Pressure Loss in Round Elbows?* by R. K. Guthrie, in the March HPAC, is a valuable addition to present knowledge of pressure loss in elbows. The early tests by Frank L. Busey, ASHVE Transactions, 1913, have been open to criticism due to the method of test. Mr. Guthrie's results are from 40 to 50 percent higher than those of Mr. Busey. In elbow tests in square ducts, reported in *Fan Engineering*, I obtained about the same percentage increase over Mr. Busey's tests on similar ducts. It would seem, therefore, that the difference probably lies in the method of test, and Mr. Guthrie's method seems to be quite proper.

Moreover, Mr. Guthrie's tests lie in the low zone reported by D. W. Locklin's survey for the ASHAE Air Distribution Committee, *Energy Losses in 90 degree Ducts*, ASHVE Transactions, 1950. This is reasonable for the size and shape of elbow tested.

I am glad to see authoritative information presented to the public, even of limited scope. It would be well if others having useful information would make such data available.

R. D. MADISON
Director of Research
Buffalo Forge Co.

Pressure Loss in Round Duct Elbows Requires Accurate Measurement

MORE POWER to R. K. Guthrie for his experimental work and article, *How Much Pressure Loss in Round Elbows?*, in the March HPAC. I only hope he will go much further.

It seems to me that the average velocity pressure loss might well have been expressed in the equivalent lengths of straight duct.

I think the type of instruments used are also open to some question. Information of this kind could have been more accurately calculated from wet and dry bulb readings rather than from sling psychrometers. I realize this item couldn't, under ordinary circumstances, make much difference.

Our experience with pitot tubes in general indicates they are not infallible, especially where one is interested in relative capacities. If possible to use a meter, I think it might be preferable. I'll admit pitot readings probably afford the best index of pressure drop, and that such data for information purposes should also be obtained. But, after all, most engineers are most interested in relative capacities; and, it seems to me, this information could best be expressed in cubic feet per hour.

R. M. CONNER
Laboratory Consultant
American Gas Association, Inc.

Keep Oil Out of Refrigerating System; Some Oil Traps Work, Some Don't

THE ARTICLE, *Better Refrigerant Piping for Parallel Compressor Systems*, by Lincoln R. Scafe, in the March HPAC, is timely. A study of the layouts which he illustrates and describes will prove very helpful to those who wish the simplest, yet effective, method of connecting compressors, either singly or in parallel.

Personally, I believe that there is much to be discovered yet about the behavior of lubricating oil in "Freon" systems. The fact is that ever since "Freon" refrigerants were introduced, there have been questions concerning the way to handle the oil that leaves the compressor. Some claim that very little oil passes out of the crankcase of a "Freon 12" or "Freon 22" compressor, which, of course, is true when the cylinders, pistons, and rings are in good condition and no leakage occurs. However, after several months of continuous operation, there is quite likely to be some wear of the rings and probably of the cylinders too. This, under certain conditions of operation, can cause oil to pass from the crankcase into the discharge line of the compressor.

As above stated, I am convinced that there is yet much to be done before the ultimate in the design and construction of oil traps has been reached. It seems unnecessary that we should have a continuous flow of oil through the refrigerating system, including the condenser, receiver, evaporator, and suction and discharge lines. First of all, oil is a non-conductor of heat and should not be permitted to enter the evaporator if there is any practical way of preventing it. Second, the place for oil is in the crankcase, and not in the refrigerating system. Some of the oil traps available today do a reasonably good job, but others don't. A mouse trap isn't any good if it doesn't catch mice.

Mr. Scafe's comments on the necessity for a piping

design that will insure optimum velocities are certainly in line with what has been found indispensable in plants that use "Freon" as the refrigerant. His suggestion for meeting these conditions with different types of compressor installations is entirely sound; this also goes for the modulating type of compressor.

C. T. BAKER
Consulting Engineer

A Few Points Are Clarified in Corrosion Conference Report

I WOULD LIKE to clarify a few points in the article, *Corrosion of Piping, Tanks Claims Interest*, in the March HPAC.

Regarding cathodic protection of elevated water tanks, a protective coating is applied first. Then a magnesium, aluminum or zinc anode is used to protect the metal surfaces where there are defects in the coating.

To reduce corrosion, welds on acid pipe lines should be complete penetration welds, with a minimum protrusion on the inside. Further, stress relieved welds in carbon steel pipe lines and tanks will reduce corrosion by 98 percent sulfuric acid.

In connection with draining sludge from a carbon steel tank of sulfuric acid, to avoid preferential pit corrosion beneath the sludge, a caustic solution of soda ash is sometimes used to neutralize the tank, after the tank has been drained and flushed out with water.

In a discussion of freeze protection of sulfuric acid lines, the use of electric resistance heaters to prevent freezing has been reported as a safe and economical method.

Finally, although one member of the conference suggested the use of a copper inhibitor for the satisfactory use of steel for muriatic acid at 215 F, from my experience I can't believe that this would work.

JOHN L. MCPHERSON
Materials Engineer, Chemical Plants Div.
Blaw-Knox Co.

Calls for Objectivity on HTHW Vs. Steam Comparison

THERE has been a good deal of discussion lately about high temperature high pressure water systems. I want to put in my oar to bring out one phase which seems to me overlooked.

In preparing an article about one such plant, which was published in the July 1954 HPAC and in gathering information for a manufacturer interested in this subject, I was struck with the one sided viewpoint expressed by many of the proponents of this system. Many of these men are from Europe, where water has always been favored over steam. They have not been equally familiar with modern high pressure steam plants, developed in the U.S. to a high degree of efficiency. They exhibit a strong tendency to make comparisons with the steam plants they have known in their countries, or with poorly designed steam plants in this country.

The truth, it seems to me, is that between well designed plants of each type there is little choice as to first cost, efficiency, cost of maintenance, and such. Job conditions and process requirements weight the balance in favor of one or the other system.

Many steam plants have been put up in this country in a hurry — because of our rapidly expanding industries — to get the job into operation, and with but little attention to efficiency, and perhaps with too much attention to keeping the first cost down. This has led to cutting corners in design, with the result that many such plants are uneconomical to operate. Others have been overloaded almost as soon as built and have never kept up with the demand. Instead of being torn down and rebuilt, they have been added to and altered with little regard for efficiency. To compare a new modern hot water plant with such steam plants is manifestly unfair, yet this comparison is often made.

As an example, the proponents of water systems invariably claim that there is never, or hardly ever, any make-up water needed, whereas they say that all steam plants require a lot of make-up. Some of the figures I have read on this are absurd. This isn't playing fair. A properly designed and maintained steam plant requires no more make-up water than a hot water plant. If process steam is required which cannot be returned, then the hot water plant would be under the same handicap or even worse. Leaks in a hot water system obviously waste a lot more water than in a steam system. In fact, with hot water such leaks simply cannot be tolerated, whereas with steam there is a tendency to let such leaks go — which is poor maintenance — and never mind the make-up.

For the transmission of large quantities of heat for considerable distances, as in a widespread distribution system with a central plant, high temperature high pressure water has definite advantages, but let's give credit where it belongs and not get so enthusiastic about one system that we lose our objectivity.

LEWIS SMITH
Heating Engineer

Chart in March HPAC Data Sheet Is for Carbon Steel Piping

I WANT to emphasize the fact that the chart on page 146 in the data sheet, *How To Determine Expansion in Carbon and Alloy Piping*, in the March HPAC, by me, applies only to carbon steel piping.

The chart is correct for carbon steel piping, and it should be used only for those materials that have thermal expansion properties similar to those of carbon steel piping. The caption for the chart states that the chart is for carbon steel piping, but I feel that it should be emphasized here.

ROBERT J. RUBEY
Mechanical Engineer

ANOTHER CASE OF COPPER WHERE IT COUNTS

AIR CONDITIONING LINES

HOTEL IRVIN COBB

PADUCAH, KY,

Consulting Engineers: FERRIS & HAMIG, St. Louis. Mechanical Contractors: SHELBY SKIPWITH, INC., Memphis, Tenn. Revere Distributor: HENRY A. PETTER SUPPLY CO., Paducah, Ky.

Photo at right shows lines of Revere Copper Water Tube extending through ceiling. Just figure the time and trouble that would have been involved if threads would have had to be cut and wrenches used. You never have to worry about wrench room with Revere Copper Water Tube and solder fittings. You can work in the most confined spaces with ease. Also, you are assured of joints that stay tight.

Revere Copper Mains extending through floor. More than 6,180 feet of Revere Copper Tube was used in sizes ranging from ½" to 2". A 250-ton cooling unit takes care of the air conditioning of each guest room by a separate, individually controlled room unit.

● The Hotel Irvin Cobb, first existing hotel in the State of Kentucky to be completely air conditioned, is still another fine example of how well copper tube fits into the installation of air conditioning equipment. This is particularly true in existing buildings where working space is at a premium and where it is desired that only the absolute minimum amount of ripping up and redecorating be done.

Then, too, Revere Copper Water Tube has the added advantages of being non-rusting, light in weight, easy to handle . . . requires fewer fittings, less time for connecting and no need for threading. Cost? Many contractors tell us that copper costs *less* than rustable materials. So why take chances? Keep out of trouble with enduring, non-rusting Revere Copper Water Tube.

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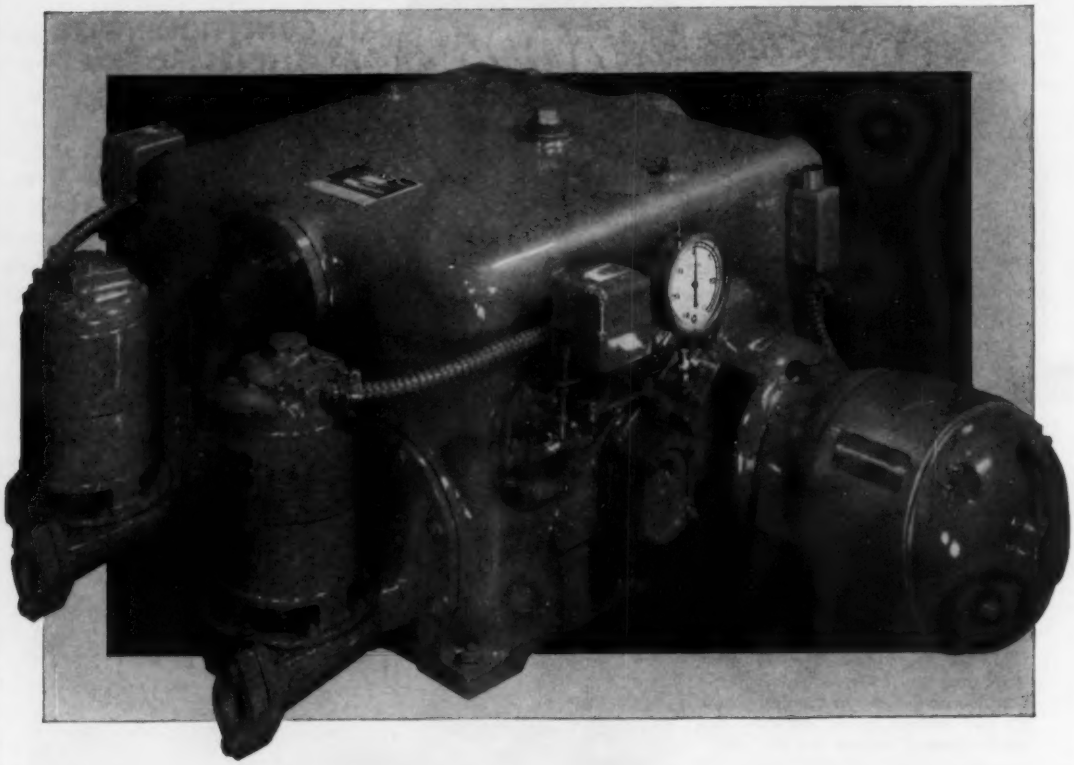
Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y. Sales Offices in Principal Cities, Distributors Everywhere.

THIS NEW VACUUM HEATING PUMP

HAS THE INCREASED AIR CAPACITY EFFICIENT HEATING PRACTICE DEMANDS



It's the Nash CSM

Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
437 WILSON, SO. NORWALK, CONN.

"Most Engineered" Hospital

1 GLASS AREAS extend from floors to ceilings in waiting rooms. Forced circulation heaters concealed in the walls supply the grilles under the windows

Careful planning included the use of room mock-ups to study air distribution. Among the results, too, was the installation of radiant baseboard "upside down."

By Harry J. Scharres
Design Engineer
E. R. Gritschke & Associates, Consulting Engineers

THE MOST engineered project in Rockford, Ill., is what citizens say about the ultra-modern 237 bed, 168 room Memorial hospital, recently completed. Two different architectural firms, a hospital consultant, a consulting engineer, and a research laboratory all participated in the planning of this 176,651 sq ft "hotel for the sick." And if all the people who had a part in the three years of basic study and in the ultimate design were to line up single file, the line would stretch some 375 ft — the distance from the hospital's basement boiler room to the upper penthouse.

But no attempt will be made here to outline the basis of design or to discuss mechanical features which may be common to any hospital. Rather, here is a brief description of the process of planning and of some of the unusual or more interesting elements of design which may be adapted for future projects. The author makes no pretense of being entirely responsible for the work and ideas presented here.

Copyright 1955 by Harry J. Scharres

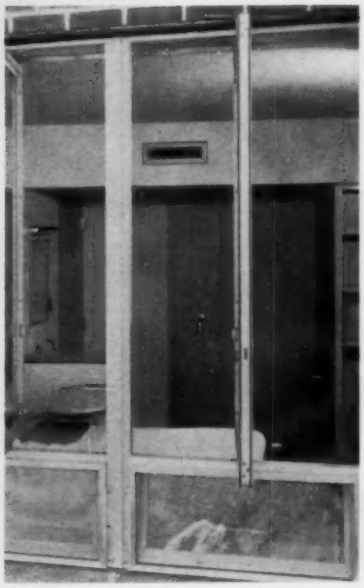
The controlling objective was to determine the most practicable arrangement of space and equipment for the maximum comfort and convenience of the patient, nurse, doctor, visitor and operating personnel. Each of these occupants, it was found, had distinct requirements which affected the design of the mechanical system.

About two-thirds of the rooms are private, and one-third are two bed rooms. No adult patient rooms have more than two beds.

Room Mock-ups Built

The comfort of the patient being the first consideration, the engineering study began in the laboratory

The new hospital is already being expanded. One of five new

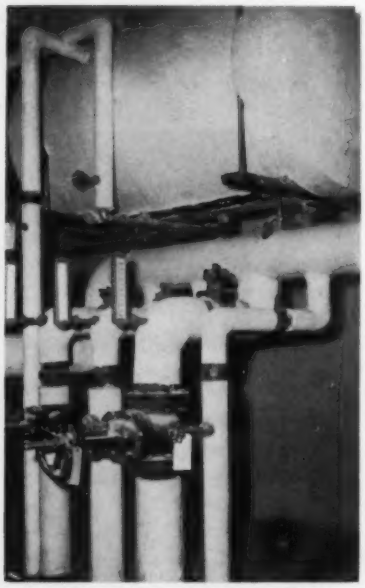


2 BEDROOM MOCK-UPS were built before working drawings were begun. Design was strictly adhered to, as is shown by the completed room, right

3 ATOMIZING HUMIDIFIERS in children's rooms use distilled water. Specially built stainless steel diffusers are used here

5 RIGHT UNDER THE WINDOWS, finned pipe convectors are used in laboratories and utility rooms where counters are on outside walls

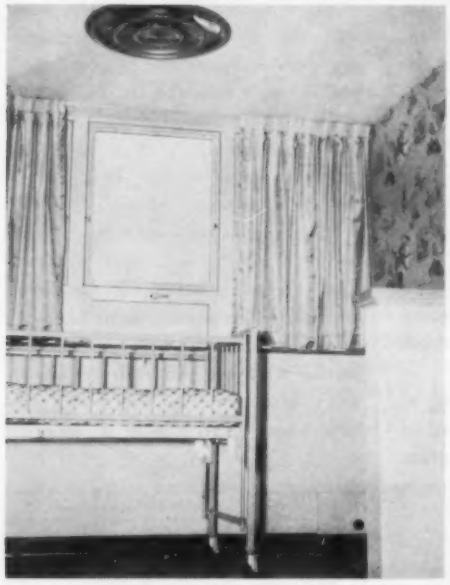
6 MOUNTED ON EACH UNIT, and also available in book form, is a system diagram for each supply and exhaust system

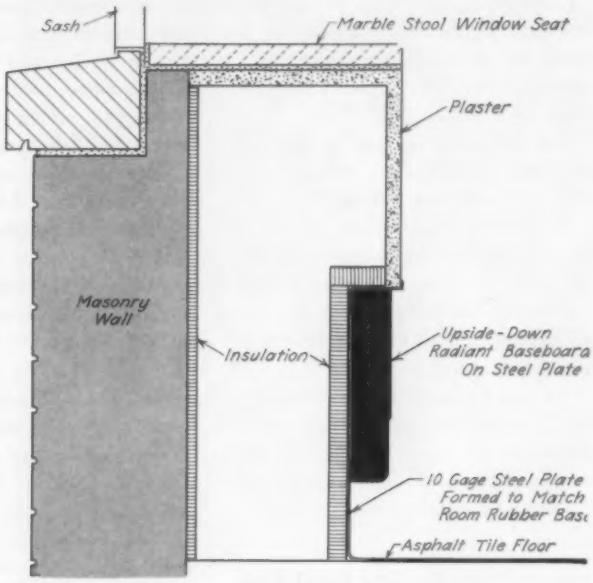


7 EXPANSION TANK for the hot water heating system is at the highest point and is the termination of all zone return mains

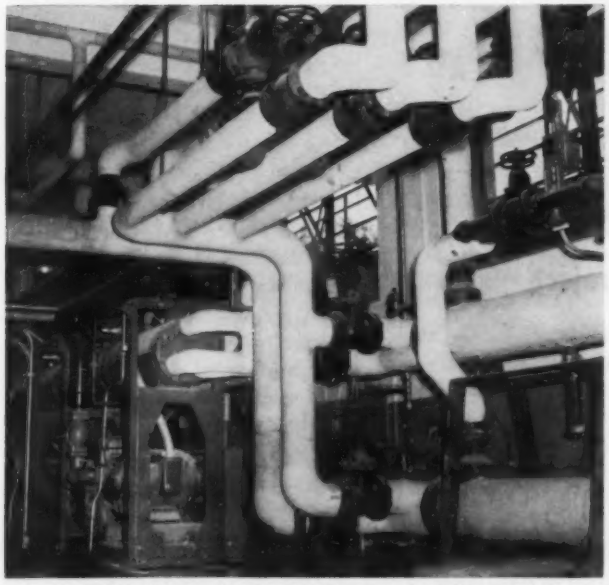
with heating and ventilating. One study involved patient room ventilation. Two full size room mock-ups were built of the private and semi-private rooms. See Fig. 2. The investigation was to establish, among other things, the optimum air quantity for circulation in the rooms. Various grille arrangements and air temperatures were tried. Velocity measurements were taken at over 150 points in each room. It was found

projects is the complete air conditioning of all medical spaces





4 CAST IRON RADIANT BASEBOARDS, mounted "upside down" on recessed steel plates, heat all patients' rooms



8 PACKAGE WATER CHILLERS at the left serve the air conditioning system. The arrangement of the two hot water heating convertors on the right and the zone three-way mixing valves show pipefitters' craftsmanship

9 ALL CIRCULATING pumps are arranged for easy operation and maintenance

that a 100 cfm, 15 in. × 4 in. grille, with 363 fpm face velocity in the private rooms, and a 200 cfm, 24 in. × 4 in. grille, with 440 fpm face velocity in the semi-private rooms prevented dead spots and limited the air motion over the top of the bed to approximately 10 fpm. The tests also showed that with the present arrangement summer air conditioning could easily be accomplished with no appreciable effect upon circulation in

the room. Air temperatures as low as 58 F were tried with excellent results. The basis of design developed in the laboratory was strictly adhered to in the final design, as is shown by the similarity between the mock-up and the completed hospital room — Fig. 2.

The air system for patient rooms is primarily a ventilating system and, although sufficient heating capacity is available to heat entirely by warm air, it is intended as standby capacity only. A system of upfeed, forced circulating hot water is installed for all heating in both ventilated and unventilated spaces.

All zone return mains terminate at the expansion tank in the penthouse — see Fig. 7 — where air is constantly bled from the piping system into the expansion tank.

Upside-Down Radiant Baseboard

The heating element in the patient rooms is a clean, off the floor, inconspicuous and safe radiating surface. Fig. 4 shows the completed unit, which consists of a section of cast iron radiant baseboard, type R, mounted upside-down on a steel plate that forms a wall recess. The lower portion of the steel plate, below the heating element, is painted black to match the rubber base in the remainder of the room and also to provide a surface to mop against in cleaning the floor. The recess is necessary since the window stools are low enough to be used as seats in most rooms, and it's important to keep a relatively high temperature heating surface beyond the normal reach of bare ankles.

The total heat output of the special baseboard arrangement was tested in a mock-up similar to the diagram shown in Fig. 2. The rating was established as 450 Btu per lineal foot of element at 210 F average water and 72 F room air, which is the normal rating of the element when mounted in the conventional manner.

Another special heating element serves the many laboratories and utility rooms where work counters are next to outside walls. Fig. 5 shows a finned pipe convector built into the wall. The heavy stamped steel cover forms the window stool and is easily removed for cleaning.

Heating the four waiting rooms — one on each floor — which have glass from floor to ceiling is done by air grilles mounted as shown in Fig. 1. The grilles are supplied from a force flow heater, concealed in a wall and accessible from an adjacent stairway. This arrangement has been effective in preventing condensation on the windows and also in preventing cold downdrafts, which are common where large glass areas occur.

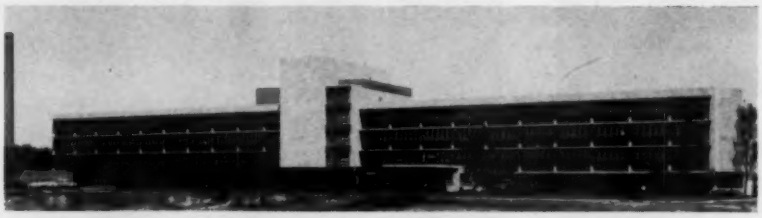
Plan Full Air Conditioning

The results of medical research during World War II, and immediately after, emphasized the importance of environment in the success of surgery, therapy and convalescence. It is therefore impossible to design a modern hospital today and not consider air conditioning as a therapeutic tool. However, the initial cost of a completely air conditioned hospital building is often prohibitive in the building budget, and it becomes difficult to draw a line between necessity and convenience with regard to air conditioning.

In the case of Rockford hospital, all major working areas are completely air conditioned. These include surgery, maternity, pediatrics, nurseries, a group of patient rooms and many smaller areas used for special research or treatment. Additional ventilated spaces, which include the kitchen, cafeteria and the remaining patient rooms, lack only refrigeration for complete air conditioning.

At the present time, the building is approximately 25 percent air conditioned. Plans are underway to increase the refrigeration capacity from the present 100 tons to 400 tons, which will allow 100 percent air conditioning of medical spaces.

An air conditioning system diagram was provided by the temperature control manufacturer to assist



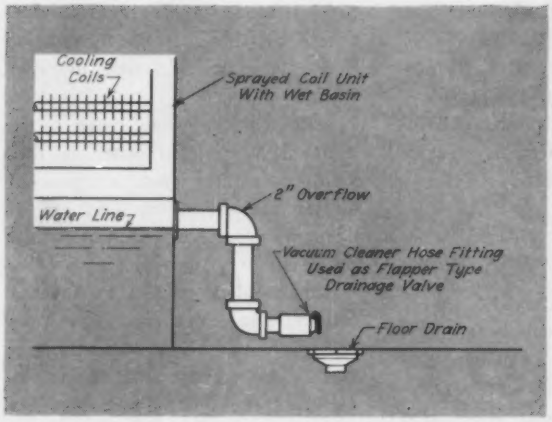
New Hospital Is Community Project

THE NEW hospital, costing $4 million and the pride of Rockford, is the product of enthusiastic community effort. Faced with an increased population due to greater industrial activity in World War II, the citizens as early as 1942 gave more than $300,000 for expansion of the old hospital. Wartime shortages prevented building at that time. By 1946 the fund had reached $1 million. The plan evolved to build a new hospital since the old one had been enlarged and remodeled several times and further expansion was deemed infeasible.

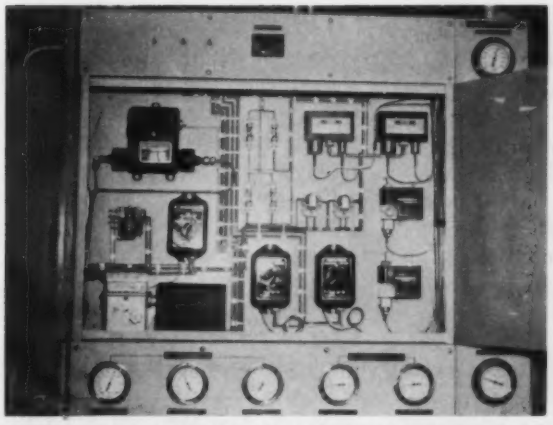
Contributions ranged from 25 cents to more than $300,000. Fiercely proud of their community dream and determined to achieve it without outside aid, the citizens spurned any public funds for the hospital.

And on moving day, the spirited citizens gave volunteer help in the transfer of patients, supplies, equipment and furnishings from the old hospital to the new. Guided by a detailed master plan, the gigantic move was completed in three days.

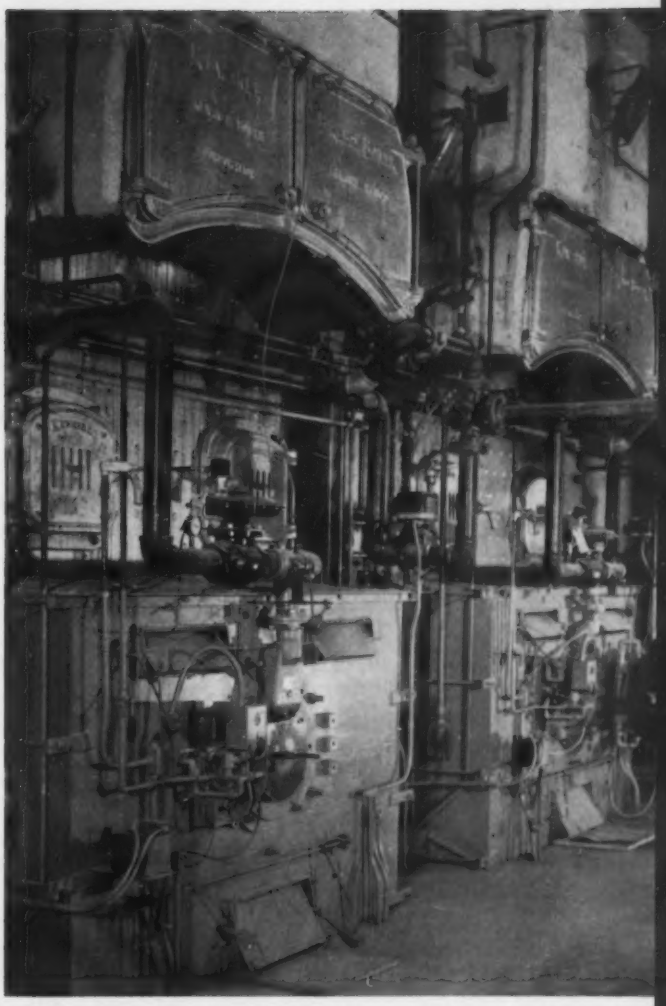
But the citizens are not resting on their laurels. Opening this spring is the $600,000 nurses' home, a further step in the realization of one community's dream of adequate hospital service to keep pace with the city's growth and with modern standards of medical care.


Cooling Coils
Sprayed Coil Unit With Wet Basin
2" Overflow
Water Line
Vacuum Cleaner Hose Fitting Used as Flapper Type Drainage Valve
Floor Drain

10 VACUUM CLEANER HOSE FITTING, used as flapper type drainage valve, has a gasketed cover which remains closed until a head of water sufficient to overcome the suction of the fan is built up in the vertical overflow pipe



11 REFRIGERATION CONTROL PANEL contains operating controls for the entire system. Gages indicate: (1) condenser water temperature, in and out; (2) chilled water temperatures, in and out; (3) compressor suction and discharge pressures; and (4) oil pressure. Motor starter controls for two 50 ton compressors are at the left and right



12 THE THREE BOILERS each have 2500 sq ft of heating surface and develop 375 hp each. Only two boilers are in operation now, the third being for future needs. One boiler has a gas burner and the other an oil burner, both of the modulating type and equipped with overfire draft control

in proper operation and maintenance. Each of the major systems — 11 supply and six exhaust — is diagrammed in a similar manner, and a copy is mounted on the casing of each unit—see Fig. 6. Additional copies are in book form for use in other parts of the building.

The value of these diagrams to operating personnel is beyond estimation, considering that prolonged and unscheduled shutdowns for repairs could have a serious effect upon the functions of a hospital. And even the most competent operating engineers might experience difficulties in a new building. The "picture diagrams" serve to pinpoint failures and also to assist in proper maintenance to prevent failure due to unfamiliarity with the systems.

The typical reheat system has one reheat coil, with zone control accomplished by a set of mixing dampers for each zone. This arrangement has proved to be quite satisfactory in operation. The chief advantages of this method of reheat are the comparatively compact arrangement of equipment and the lower cost of dampers, as compared with individual reheat coils and controls.

Controlled Environment Rooms

Air conditioning is, in its true sense, controlled environment — temperature, humidity and air motion. The ordinary system, however, is limited to the normal range of temperature and humidity for human comfort for a healthy person. Rooms providing wide ranges in temperature and humidity and also control over air contamination — pollen,

dust, etc. — are more properly referred to as controlled environments. With such rooms available to a hospital, treatments requiring extreme conditions become a simple matter of locating the patient in the proper room and setting the desired conditions; all else is routine.

The pediatrics wing was selected for a group of controlled environment rooms primarily for two reasons: (a) The great importance of environmental factors in the treatment of very young children; (b) The difficulties experienced with the use of portable tents with children because of the necessary confinement required by the small equipment.

The room shown in Fig. 3 is essentially similar to other pediatrics rooms, except that normal patient and nursing activities can be performed uncurtailed within the room, with any degree of comfort or discomfort prescribed by the physician.

The controlled environment rooms are served from the same central conditioning system that serves the entire pediatrics wing. Extremes in dry bulb temperature are accomplished by increasing the volume of air supplied to the rooms slightly above what would be required for normal comfort. Thus a supply air temperature that will maintain 75 F in ordinary rooms will maintain 85 F in the controlled room if required.

The problem of maintaining a high humidity — 90 to 100 percent at low temperature — is a much more difficult one. Humidification is accomplished in two stages. The first stage consists of a pan humidifier, in each duct serving a controlled environment room, to provide nearly saturated air leaving the fan room. The second stage consists of a centrifugal atomizing type humidifier within each room.

An automatic water still to supply distilled water to the atomizing humidifiers is necessary in Rockford because of the high mineral content of the city water. Condensation will occur on the walls and windows under some conditions, and mineral deposits on these surfaces would quickly mar the appearance of the rooms. The still is installed in the fan room, where it receives regular maintenance along with other equipment. A system of aluminum piping distributes the distilled water by gravity to the room humidifiers.

Central Oxygen Supply System

A convenient and readily available piped oxygen supply at each bedside affords the physician and the patient the advantages of oxygen as often and as long as required at a minimum of expense. The economy of gas alone is substantial, in addition to the savings in time for maintenance personnel in transporting and servicing portable units.

The central system has an outdoor bulk storage unit which serves one riser in the central part of the building. The riser feeds three horizontal distribution mains on each floor. Individual room outlets of the plug-in type are flush with the wall and resemble electrical receptacles in appearance. Sectionalizing valves are installed at each main connection to the riser. In addition, each operating and delivery room supply is valved outside the room.

The entire piping system is concealed and consists of seamless copper tubing with copper valves and fittings. Generally speaking, the only servicing required for the central oxygen system is the regular filling of the bulk storage unit.

In addition to gas economy, less maintenance, and ready accessibility, advantages include better sterile technique, no interruption for cylinder change, and saving of equipment storage space. The system is expected to amortize its initial cost in two to five years.

Solve Check Valve Problem

An interesting problem that developed into a long search was the need for a special check valve on overflow drains from the sprayed coil units and from the filter wash basins. If the drains were left open — as is the usual practice — they would present a source of air contamination since they are on the suction side of the fan and after the electrostatic filters.

Such a valve would have to remain tightly closed with as little as ½ in. water gage air pressure on the outside of the unit and to open when a head of water built up in the overflow pipe.

The problem seemed to have no solution until work on another project pointed out the way. The answer was to use a vacuum cleaner hose outlet of the type used for central vacuum cleaner systems. This relatively inexpensive valve has proved to be most satisfactory in operation. See Fig. 10.

Provisions for the Future

Plans for future expansion, which seemed remote during the basic planning stage, are materializing many years sooner than anticipated. In Rockford, five future projects were anticipated: (1) Nurses' home; (2) 100 percent air conditioning; (3) Medical Arts building; (4) More treatment areas; (5) More laboratory facilities. Four of these are already under construction or are in the final planning stage.

It is particularly true in the hospital field that the need will often provide the means. It is also true that the mechanical designer's judgment of future needs will often make the difference between economical expansion and an almost impossible rebuilding.

As evidence of the complexity of the plant as it stands today, some 300 employees are required to accommodate the full complement of 237 patients.

Architects for the hospital were Hubbard and Hyland, of Rockford, and Perkins and Will, of Chicago. Consulting engineers were E. R. Gritschke & Associates, of Chicago. The heating contractor was Rockford Industries, and the air conditioning contractor was H. S. Kaiser Co., of Chicago. The refrigeration contractor was Mid-West Heat Service, also of Chicago.

Photos courtesy of the Barber-Colman Co.

1 THIS DOUBLE OFFSET expansion U bend was made with 18 in. OD × 5/8 in. wall pipe for a vertical installation. The total length was about 92 ft and the height was almost 33 ft

Try These Rules for

Easy U Bend Design

By John E. Brock
Professor of Mechanical Engineering
U.S. Naval Postgraduate School

Double offset expansion U bends are easy to design when you follow these simple formulas in structural analysis

ANYONE who has faced the problem of designing an expansion bend to absorb thermal expansion in a long straight run of pipe is aware that generally what seems to be a simple problem turns out to require a very complicated analysis. The complications arise from the intricacies of compliance with appropriate codes or other jurisdictions and from the fact that the structural analysis is invariably much more involved than one would anticipate.

However, if one uses the code provisions which are recommened in the Report of the Task Force on Flexibility[1] and which have recently been made permissive for use by the American Standards Association *Code for Pressure Piping*,[2] the question of code interpretation is simplified so that the real difficulties reside in the structural analysis of the expansion bend.

For most shapes, there are a rather large number of factors which enter into the problem such as the width, height, bend or elbow radius, flexibility factor, stress intensification factor or type of constraint. However, the analysis becomes beautifully simple in the case of one of the most widely used configurations for accommodating thermal expansions in long runs, the graceful double offset expansion U bend shown in Fig. 1.

Upon the basis of analysis given in a recent paper[3] it is not difficult to derive the following equation for determining the required radius R of the bend.

$$R = (EXD/16S)^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots [1]$$

The symbols are defined as follows: R = Required bend radius, in. — The equation gives a minimum value. Larger values may also be used. E = Modulus of elasticity of pipe material at room air temperature, psi. X = Total expansion, in. to be accommodated by the double offset expansion U bend. — Credit for "cold-spring" or "cut short" is not permitted. D = Actual outside diameter of pipe, in. S = Allowable bending stress, psi.

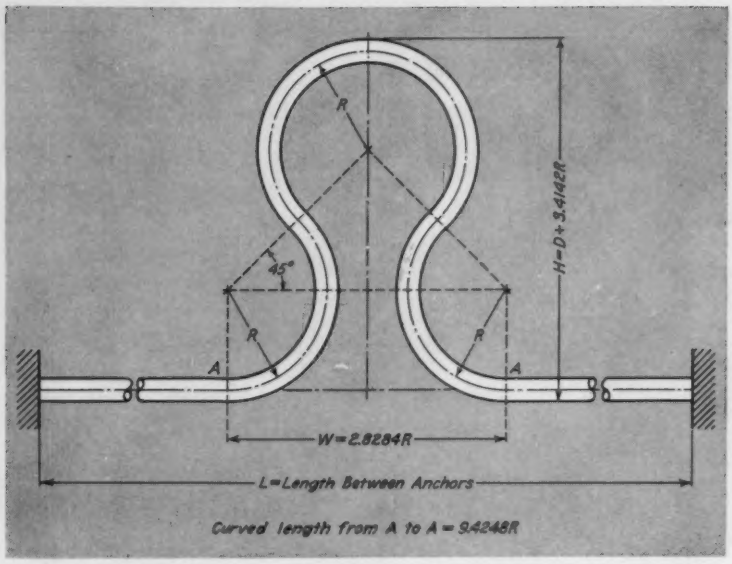
Values of E are given in Table 1. The value of X, the total expansion, is to be computed from equation No. 2.

$$X = Le \quad \ldots\ldots\ldots\ldots\ldots\ldots [2]$$

where L is the distance between anchors or fixed points, expressed in ft, and e is the inches of expansion per ft of pipe. Table 2 gives values of e for ferrous piping materials based upon expansion from true length at 70 F. The Report of the Task Force on Flexibility[1] gives data on other materials as well.

Compute Bending Stress

The allowable bending stress S may be computed from equation No. 3.



2 THE ANALYSIS OF the double offset expansion U bend becomes beautifully simple when considering these dimensions and some other factors such as flexibility, thermal expansion and moment of inertia

$$S = f\ (1.25\ S_C + 0.25\ S_H) \quad \ldots[3]$$

where f is a stress reduction factor which depends upon the number of temperature cycles which the piping is expected to withstand. Values of f are given in Table 3. The quantities S_C and S_H are the "allowable stress values" for "cold" and "hot" conditions, respectively, which are tabulated or otherwise cited in the several sections of the ASA *Code for Pressure Piping*.[4]

Before concluding this article with an example illustrating the use of the equations, it is necessary to mention some of the assumptions and approximations which are implied. In the first place, it is assumed that the pipe is well supported. Equation No. 1 does not include the effect of the weight of pipe, contents, and covering.

According to the Task Force Report, the sum of the longitudinal stresses due to pressure, weight and other sustained external loading shall not exceed S_H, but where the sum of these stresses is less than S_H, the difference between S_H and this sum may be added to the term 0.25 S_H in Equation No. 3. Since the longitudinal pressure stress is approximately one-half the circumferential pressure stress — "hoop" stress — and the latter is limited to the value S_H by the pipe wall thickness formulas, it follows that if the longitudinal stresses due to weight and other sustained external loadings are kept below the value 0.50 S_H, which in most cases can easily be accomplished by design of adequate supports, the sum of the longitudinal stresses mentioned above will indeed not exceed S_H, and the value S from Equation No. 3 can actually be increased somewhat.

On the other hand, if the double offset expansion U-bend contains joints other than butt welded joints, the allowable stress computed by Equation No. 3 should be reduced by dividing by the stress intensification factors given in Table 4, before using it in Equation No. 1.

One thing that should be noted clearly is that the value of S with which we are dealing is not a "stress" in the usual case, but rather is the "stress range" through which the configuration is permitted to operate. The values are often startlingly large, but after having examined some recent criticisms to this effect, the Task Force has reaffirmed its earlier selections which are given in the development of the Task Force Report, on pages 102, 103, August 1954 HPAC.

Another thing to be noted is that the value 16 which appears in the denominator under the square root sign is an approximation. If the bend were to be guided at Points A (see Fig. 1) by perfectly rigid guides, which permit the pipe to move axially but completely restrain it against rotation or lateral motion, the correct value would be 14.56 rather than 16. Clearly, this is an extreme of constraint unlikely to be encountered in actual practice. Even so, Equation No. 1 errs by only 5 percent in this case — the calculated value of R should be increased by 5 percent. On the other hand, in a long line with the bend lying on its side and located somewhere near the middle of the run and with long hanger rods so that very little restraint is imposed upon deformation of the configuration in its own plane, the value of the coefficient in equation No. 1 could be as large as 23.36 rather than 16, and this would result in an error of 17 percent in the value of R. In other words, R could be 17 percent smaller than calculation according to equation No. 1 would indicate. Clearly, this, too, is an extreme, and the value of 16 which has been selected represents a reasonable compromise.

What Force on Anchors?

It is usually desirable to evaluate the reactions which the piping will exert upon the anchors or equipment at the ends of the pipe. The longitudinal thrust F developed lies between the values indicated by:

$$F = EIX/12.4\ R^2 \text{ (maximum)} \quad \ldots[4]$$

$$F = EIX/39.9\ R^2 \text{ (minimum)} \quad \ldots[5]$$

corresponding to the extreme conditions described in the preceding paragraph. The degree of constraint has a much larger effect upon the thrust F than it does upon the maximum bending stress in the pipe. However, the limits indicated by equations No. 4 and 5 may prove useful in design. In equations No. 4 and 5, the symbol I denotes the moment of inertia of the pipe cross section. Values of I are given in Table 5.

Example Illustrated

Design a double offset expansion U bend for a process steam line of 4 in. ASTM A-106 grade B standard weight seamless pipe 250 ft between anchor points. There will be an average of two temperature cycles per week, the high temperature being 600 F and the low temperature being

70 F. Also, what thrust should the anchors be designed to withstand?

Solution:

From Table 1, $E = 27{,}900{,}000$ psi. Using the value of 0.046 in. per ft from Table 2, we have $X = 250 \times 0.046 = 11.5$ in. according to equation No. 2. For 4 in. IPS pipe, D has the value of 4.5 in. From Table 3, we take $f = 1.0$. It would take about 70 years to get more than 7000 cycles at two per week. Process steam lines fall under the jurisdiction of Section 1, Power Piping, of the Code for Pressure Piping, and for ASTM A-106 grade B seamless we find that $S_D = 15{,}000$ and $S_H = 15{,}000$. Therefore, by equation No. 3, we have

$$S = 1.0 \times (1.25 \times 15{,}000 + 0.25 \times 15{,}000) = 22{,}500 \text{ psi.}$$

Then, from equation No. 1, we get

$$R = [(27{,}900{,}000)\ (11.5)\ (4.5)/(16)\ (22{,}500)]^{\frac{1}{3}} = (4011)^{\frac{1}{3}} = 63.3 \text{ in.}$$

Thus, for dimensioning purposes, say $R = 64$ in. Correspondingly, the overall height H is $3.414\ R + D = 223$ in. $= 18$ ft, 7 in. The overall width W between tangent points A is $2.8284\ R = 181$ in. $= 15$ ft, 1 in. The length of pipe between tangent points is $3\pi\ R = 603$ in. $= 50$ ft, 3 in. Since pipe is usually not available in lengths greater than approximately 40 ft, this double offset expansion U bend must be formed in two or more pieces. The weld or welds may be located anywhere on the bend, even at the crown where the bending stress is the greatest, as long as the welds are sound.

Finally, from Table 4, we find $I = 7.23$ and from equation No. 5, we find that

$$F = [(27{,}900{,}000)\ (7.23)\ (11.5)] / [(12.4)\ (64)^2] = 714 \text{ lb.}$$

is the maximum possible value of the thrust exerted on the anchors. This low value should permit the use of a very simple structure at the anchor points.

TABLE 1 — VALUES of "E" — modulus of elasticity — at room air temperature of 70 F

Carbon steel (below 0.30 carbon)	27,900,000 psi
Carbon steel (medium and high carbon)	29,900,000 psi
Carbon-moly steels	29,900,000 psi
Chrome-moly steels (through 3 percent Cr)	29,900,000 psi
Intermediate Cr-Mo steels (5 - 9 percent Cr)	27,400,000 psi
Austenitic stainless steels	27,400,000 psi
Straight chrome (12 percent, 17 percent, 27 percent) steels	29,200,000 psi
Gray cast iron	13,400,000 psi
Monel (67 Ni-30 Cu; 66 Ni-29 Cu, Al)	26,000,000 psi
Copper nickel (80-20 to 70-30)	18,900,000 psi
Aluminum	10,600,000 psi
Wrought iron	29,500,000 psi

Data from Task Force Report, reference No. 1.

TABLE 2 — MEAN THERMAL EXPANSION "e" — Inches of expansion per foot of pipe in going from 70 F to the indicated temperature

Temperature, F	Group 1 — Carbon steel, carbon moly, low chrome moly (chrome not over 2¼ percent)	Group 2 — Medium and high chrome moly (5 to 9 percent chrome)	Group 3 — 18 — 8 type stainless steels	Group 4 — 25 — 20 type stainless steels
400	0.027	0.025	0.038	0.032
600	0.046	0.043	0.062	0.053
800	0.066	0.061	0.088	0.076
1000	0.088	0.081	0.115	0.100
1200	0.110	0.100	0.142	0.125

Data adapted from Steels for Elevated Temperature Service, U.S. Steel, Carnegie-Illinois Steel Company, 1949.

TABLE 3 — STRESS REDUCTION FACTORS for various temperature cycles

Total number of full temperature cycles over expected life	Stress reduction factor "f"
7,000 and less	1.0
14,000 " "	0.9
22,000 " "	0.8
45,000 " "	0.7
100,000 " "	0.6
250,000 and over	0.5

Data from Task Force Report, reference No. 1.

TABLE 4 — STRESS INTENSIFICATION FACTORS for pipe joints

Butt welded joint	1.0
Double-welded slip-on or socket weld flange	1.2
Fillet welded joint, or Lap joint flange (with ASA B16.9 lap joint stub)	1.6
Screwed pipe joint or screwed flange	2.3

Data from Task Force Report, reference No. 1.

References

1) "Report By Task Force of ASA Sectional Committee B-31," June 21, 1954. Obtainable from The American Society of Mechanical Engineers, 29 West 39th Street, New York 18. Also see August 1954 HPAC, pp. 98-101.

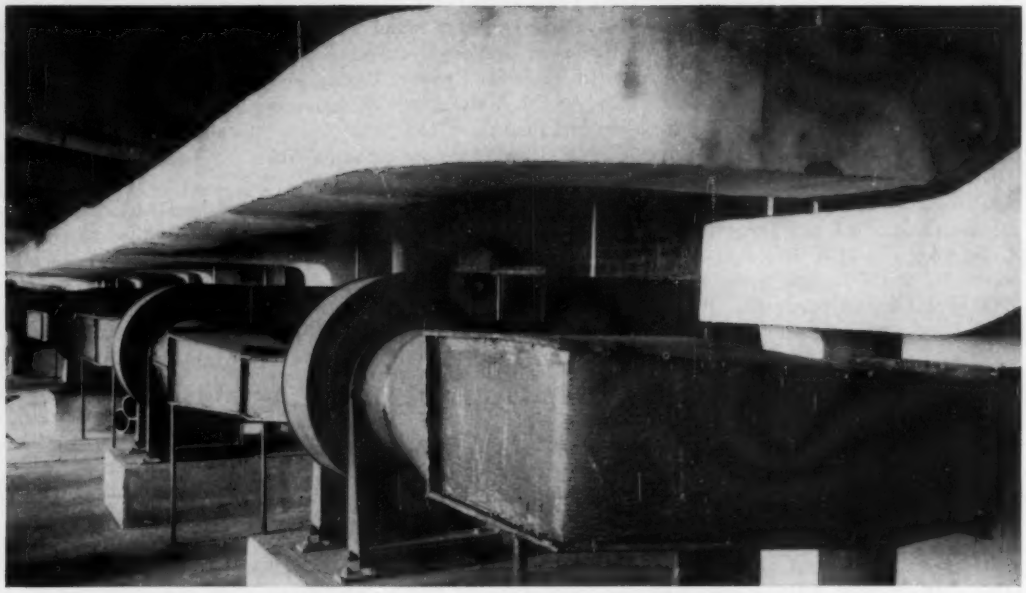
2) See Case 13 as given on p. 101, August 1954 HPAC.

3) "Flexibility of Piping Systems Supported by Equally Spaced Rigid Hangers," J. E. Brock, Journal of Applied Mechanics, Vol. 21, No. 1, March 1954, pp. 11-18. (ASME Transactions, Vol. 76).

4) *ASA Code for Pressure Piping* (B31.1-1951) and Supplement No. 1 (B31.1a-1953), Price $4.00. Also "Gas Transmission and Distribution Piping Systems" (B31.1.8-1952), Section 8 of *Code for Pressure Piping*, Price $1.25. Both documents published by The American Society of Mechanical Engineers, 29 West 39th Street, New York 18.

TABLE 5 — MOMENT OF INERTIA "I" of pipe, lb in.²

Nominal	Iron Pipe Sizes, in. Std	XS	XXS	Schedule Number 10	20	30	40	60	80	100	120	140	160
2	0.666	0.868	1.31				0.666		0.868				1.16
2½	1.53	1.92	2.87				1.53		1.92				2.35
3	3.02	3.89	5.99				3.02		3.89				5.03
3½	4.79	6.28					4.79		6.28				
4	7.23	9.61	15.3				7.23		9.61		11.7		13.3
5	15.2	20.7	33.6				15.2		20.7		25.7		30.0
6	28.1	40.5	66.3				28.1		40.5		49.6		59.0
8	72.5	106	162		57.7	63.4	72.5	88.7	105	121	141	154	166
10	161	212			114	137	161	212	245	286	324	368	399
12	279	362			192	248	300	400	475	562	642	701	781
14	372	484		255	314	373	429	562	687	824	930	1030	1120
16	562	732		384	473	562	732	932	1160	1360	1560	1760	1890
18	807	1050		549	678	930	1170	1510	1830	2180	2500	2750	3020
20	1110	1460		757	1110	1460	1700	2260	2770	3320	3760	4220	4590
24	1940	2550		1320	1940	2840	3420	4650	5670	6850	7830	8630	9460



1 MAJOR PHASE of ventilation at the Institute is the circulation and cleaning of the air in 244 laboratories and offices. A manifold duct and exhaust fan system withdraws fumes from hood flues

Clean Air Aids Research Institute

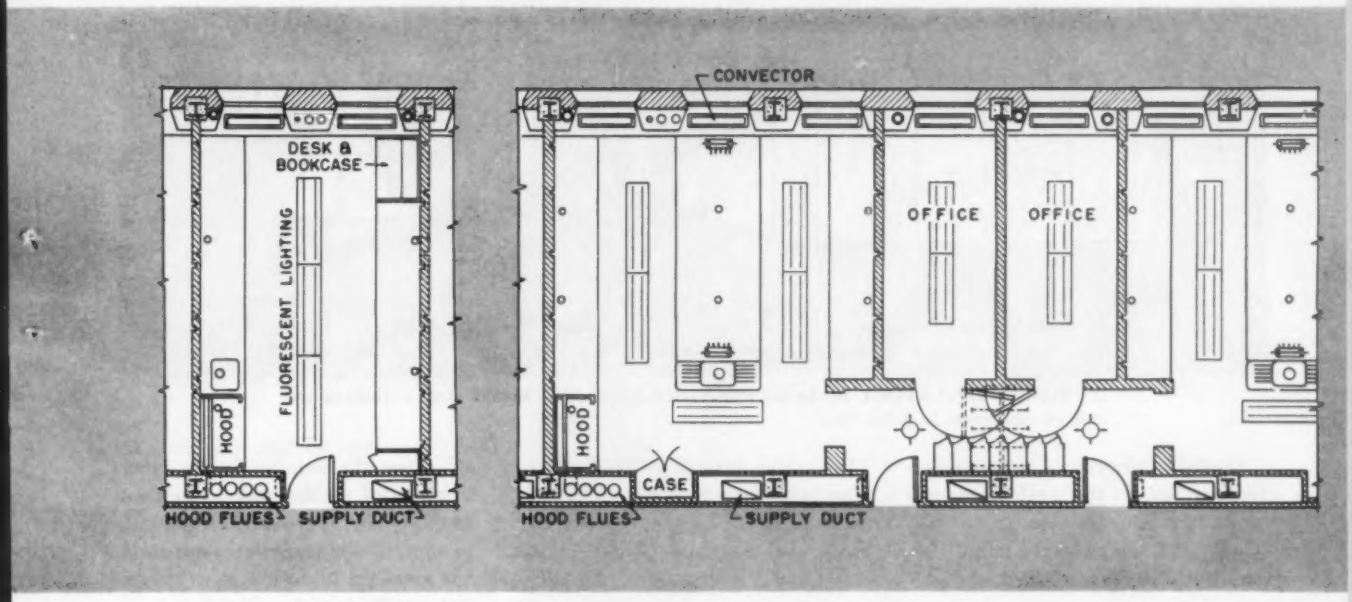
. . . increases accuracy, cuts maintenance

• This air system is a pioneering installation of its size. Described here for the first time are the details of supplying outdoor air, cleaning it and exhausting it for maintaining a "precision environment."

By George E. Landgraf
Vice President, Engineering
Trion, Inc.

GREATER ACCURACY in research studies, a reduction in cleaning requirements, and a healthier atmosphere for workers have all been experienced at the Mellon Institute, Pittsburgh, as a result of its air cleaning system.

To cite one specific advantage in maintenance, the cleaning of building walls has been reduced from once every month to once every four months. Similar gains have been made in keeping the huge research structure immaculate for scientific work. Electrostatically cleaned air has often proved essential for preventing contamination in biological studies where mold spores, bacteria and pollens are subjects. It has contributed to greater efficiency and has benefited a number of studies where



2 LABORATORIES are of two sizes, as shown here. A battery of 52 fans on the floor above exhausts air through the laboratory hoods

purity and exact measurement of materials were crucial factors.

It was felt from the time the Institute was designed, that air cleaning would be important in the operation. These views were strengthened by the early studies in air purification, dirt and smoke problems, in which the Institute pioneered, and by partial trials with air cleaning. Today, after sufficient time to substantiate its effectiveness, it is believed that the Institute's experience justifies this article —the first to be published—that describes the scope and operation of the air cleaning systems and the results experienced.

Modern Scientific Workshop

The Institute functions in one of the world's largest and most completely equipped buildings devoted solely to scientific research. The structure covers a trapezoid city block, 306 ft in front, 334 ft from front to rear, and 184 ft across the rear. Wings in the form of a cross divide the central court up to the fourth floor. Above that, the front-to-rear wing only is at full building height. There are nine floors, comprising 6,500,000 cu ft.

In the original construction, provision was made for the air intakes, outlets and ductwork to be used in air washing, although the fan and cleaner system was not completed at that time. About 28 percent of the area for laboratories and offices remained unfinished, and it was not until the late 1940's that the building was completed. Full scale air cleaning then began for all rooms except those on the first floor and parts of the second floor.

Air Supply, Cleaning Separate

Air supply and cleaning are handled separately for several portions of the building. Most of the laboratories where the 80 fellowships conduct research are on the fifth through the eighth floors, and these laboratories are provided with interesting ventilation and air cleaning systems.

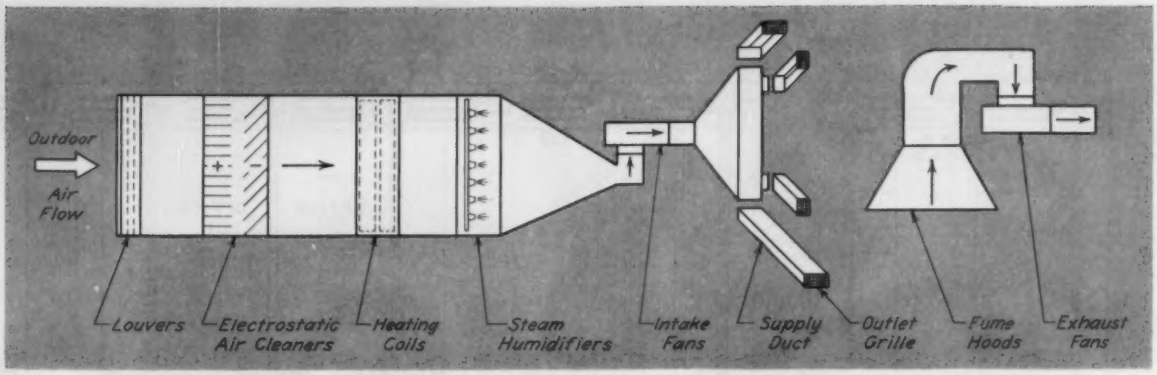
Most of the laboratories are of two sizes (see Fig. 2). The larger rooms are generally in pairs with a common entry.

The total volume of these laboratories, omitting the special laboratories and offices, is 547,498 cu ft. It is the circulation and cleaning of the air in this space which might be called the major phase of the ventilation at the Institute.

Air Filtering Important

Before the final air handling equipment was installed, air filtering came to be recognized as increasingly desirable for many research studies, particularly in biological studies and in certain product analysis programs. An additional and by no means negligible consideration was the beneficial influence of a germ- and dust-free atmosphere on researchers' health, which has maintained an unusual freedom from respiratory diseases.

The system begins with the outdoor air intakes covered with aluminum grilles, which open on the court at the ninth or attic floor. Behind these are stormproof louvers of heavy aluminum. Multi-leaf dampers which regulate the inward flow of air close automatically when the intake fans shut down and open when they start.



3 SCHEMATIC LAYOUT of the air intake, cleaning, heating, humidifying, circulating and exhaust equipment is shown here

Eighteen electronic air cleaners are installed on the ninth floor just inside the multi-leaves. These are standard custom-packaged units. The negative plates are flushed periodically by hot water through fixed nozzles.

Dust spot tests developed by the National Bureau of Standards show that the equipment removes 90 percent of the foreign matter and dirt from the air drawn into the building. The sizes of particles removed are as small as 1/100th of a micron. Since bacteria average about one micron in size, much of the minute living organisms, pollens, fungus spores, germs and many other viruses carried in the air is eliminated, together with inanimate matter such as fly ash, dust and smoke.

Heat and Air Supply

Next in line are non-freeze, nonferrous fin type heating coils for modifying air temperature in the cold season. Steam at 5 psi is supplied from heating mains and controlled through automatic valves actuated by thermostats in the fan discharge ducts. A steam humidifier follows, which is controlled by an automatic steam valve actuated by a humidistat.

Beyond this equipment are 17 intake fans, the backward curved blade type with single speed motor. These are set on rubber-in-shear vibration bases. One fan is used for each air supply system, five of which furnish cleaned air to the corridors on the fifth to eighth floors inclusive, and 12 of which furnish air to the laboratories on these floors.

The fans serving the corridors are above the ends and centers of the corridors. Those serving the laboratories are spaced along the court walls so that each serves a group of rooms on floors directly below. Ducts direct the air down into the corridors or rooms through grilles in the walls. Since ducts pass between two faces of terra cotta wall, sheet metal painted inside and out with asphaltum paint was employed for permanency.

Thus, a total of 78,340 cfm of electrostatically cleaned air can be furnished to the fifth to eighth floors, with 18,700 cfm entering the corridors and 59,640 cfm entering the laboratories. All air supplied to these floors is exhausted through toilet or laboratory outlets or windows.

Laboratory Exhaust System

In designing the laboratories, careful consideration was given to the removal of dangerous or obnoxious fumes. Specially designed fume hoods were installed in all the laboratories.

The hoods are open-front type, 54 in. long and 30 in. deep, with a clear opening in front which is 33 in. high. Inside height is about 60 in. Ingenious controls permit the draft to be applied at the hood top for light gases or at the bottom for heavy fumes in any ratio desired. The fan for any hood can be turned on in any one of the laboratories served by it but cannot be turned off unless the switches in the other laboratories on the same air circuit are also off. Therefore, no fan can be shut off while any laboratory still has a use for it.

An individual flue of 8 in. chemical stoneware runs from each hood to the ninth floor. These groups of several flues are connected to a manifold and to a fan. Fan discharge is through metal ducts which carry the fumes out into ceramic elbows in a shallow air trough above the attic and then into the atmosphere. There are no vents that mar the symmetry of the building as viewed from the street.

A battery of 52 fans, spaced around the outer walls of the ninth floor, causes the exhaust air to move from the laboratory hoods and toilets. Each fan is installed so as to serve the hoods in laboratories on floors directly beneath it.

The exhaust system comprises 45 laboratory exhaust fans with a combined capacity of 233,160 cfm, and seven toilet exhaust fans with a combined capacity of 19,475 cfm. Their total capacity is 252,635 cfm. Normally only half or less of the laboratory fume exhausts are in use at one time.

First to Fourth Floor Areas

To understand the air handling systems for the first to fourth floors, it is necessary to know the functions of these areas. The first floor, almost three stories below ground, has much of its space allocated to unit plant installations and large engineering

laboratories. On the second floor, an auditorium occupies the center wing from the cross wings to the rear and is two stories high. Service shops, cold storage, X-ray and spectroscopic laboratories are also on this floor.

The third floor contains the upper part of the auditorium, the outside entrance and lobby for the auditorium, social rooms, kitchens, storage facilities and special laboratories. The fourth floor contains the main lobby, a large library above the auditorium and executive offices.

Air Supply and Exhaust

Outdoor air intakes for all four lower floors are in wells covered with heavy metal grilles in the paved porch area above street level. Air for third floor laboratories and fourth floor offices is drawn in by fans on the third floor, passing through electrostatic filters and tempering coils similar to those previously described. The rooms named on the third and fourth floors are served by five intake fans capable of supplying 51,735 cfm.

Air exhaust for all lower floors passes out through wells or shafts similar to those for the air intakes. Exhaust fans for the third floor laboratories and for the fourth floor offices are also on the third floor. There are four of these units, having a total capacity of 29,900 cfm.

Electrostatically cleaned air is not essential to the heavy machine shop operations on the first and second floors. However, all air supplied to these floors is filtered through throwaway filters. These service and shop sections are served by two intake fans of 32,800 cfm capacity, and two exhaust fans of 21,200 cfm capacity.

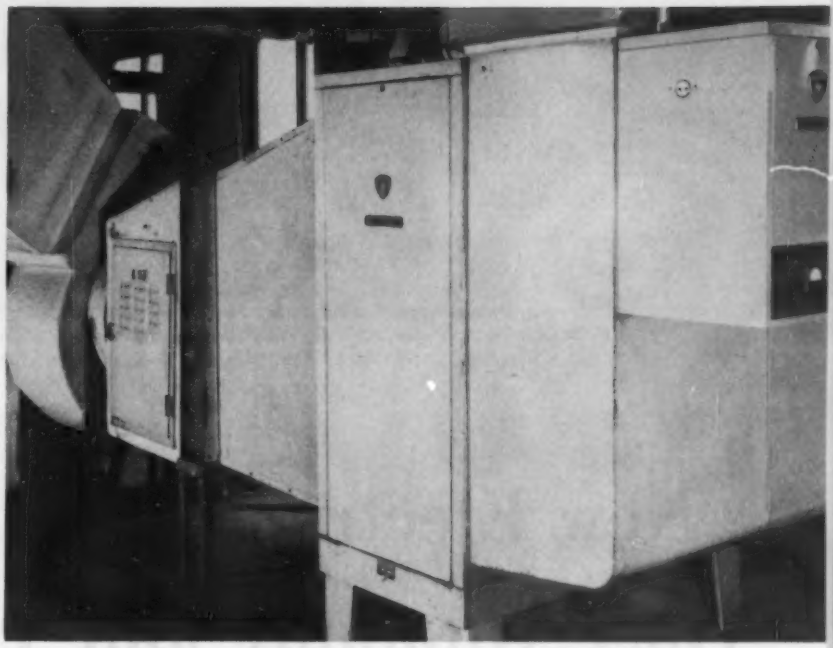
Special Installations

Besides the general ventilation provisions described above, several special air supply systems operate in the building.

The chief system is for the auditorium and library which take up substantial portions of the second, third and fourth floors. The arrangement comprises an intake fan which can produce from 2800 cfm to 7500 cfm, an air cleaner and an oil filter, a 2500 cfm exhaust fan, and a 40 ton refrigerating machine. Provision is also made for recirculating as well as exhausting the air. At peak intake volume, air can be changed in both rooms every three minutes if desired. Normally, however, the air supply fan is run at 1/10th of its peak capacity.

Individual cleaning systems are likewise installed for constant temperature laboratories on the sixth floor. These are self-contained packaged units complete with exhaust. Two of these units have intake capacities of 2400 cfm and exhausts of 800 cfm each, while the other two have intake capacities of 3000 cfm and exhaust capacities of 1000 cfm each.

The physical measurement rooms on the third floor are served by a fan which provides electrostatically cleaned air at 3200 cfm with a built-in exhaust fan of 1000 cfm. On the second floor, the spectrographic laboratories are served by two intake fans of 4800 and 2400 cfm respectively and by exhaust fans of 1600 cfm and 900 cfm.



4 PERIODIC FLUSHING of negative plates of 18 electronic air cleaners installed on the ninth floor is by hot water through fixed nozzles

Summary of Fan Capacities

Equipment for the artificial circulation of air for the building as a whole is thus capable of drawing in a total of 191,575 cfm and exhausting 313,235 cfm. The hood exhaust system for the individual laboratories, seldom used at as much as half capacity, accounts for the exhaust potential exceeding the intake. Of the total intake capacity, 159,575 cfm, or 83 percent is electrostatically cleaned.

Maintenance

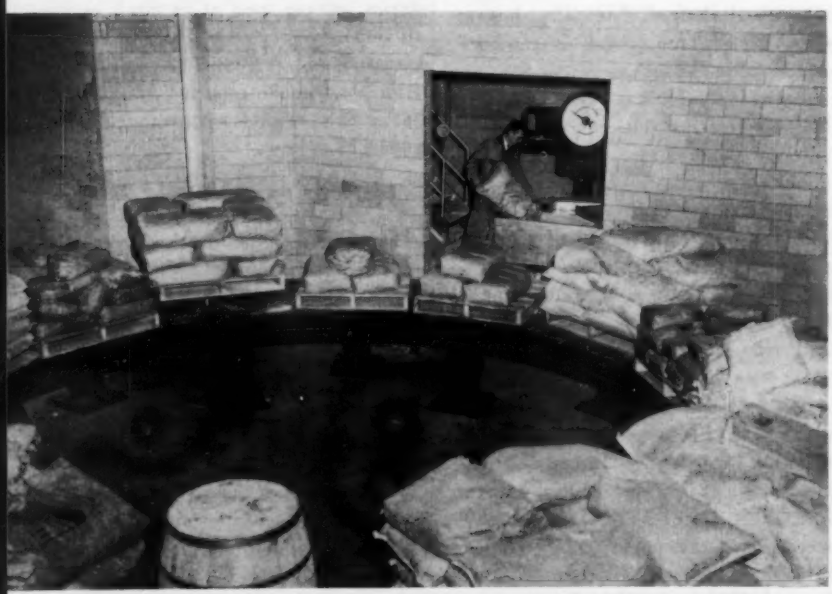
The air circulation is maintained continuously, although with considerable variations in the amount of air moved, except for the weekly shutdown for cleaning and maintenance, which takes about eight hours. Maintenance costs for the air cleaners are reported to be small in relation to the quantity of air moved, requiring about an hour's time each month for both cleaning and repairs per unit. In addition, clean air has substantially reduced the costs of maintaining the cleanliness of the building, which is of course most desirable.

1 WINDOWLESS except for the offices, new electrode plant of the A. O. Smith Corp. is provided a completely controlled air flow, with maximum emphasis on the exclusion of dust

New Electrode Plant Conquers Dust, Humidity and Temperature

. . . by combined ventilating and air conditioning

By John A. Lofte
Lofte & Fredericksen, Consulting Engineers



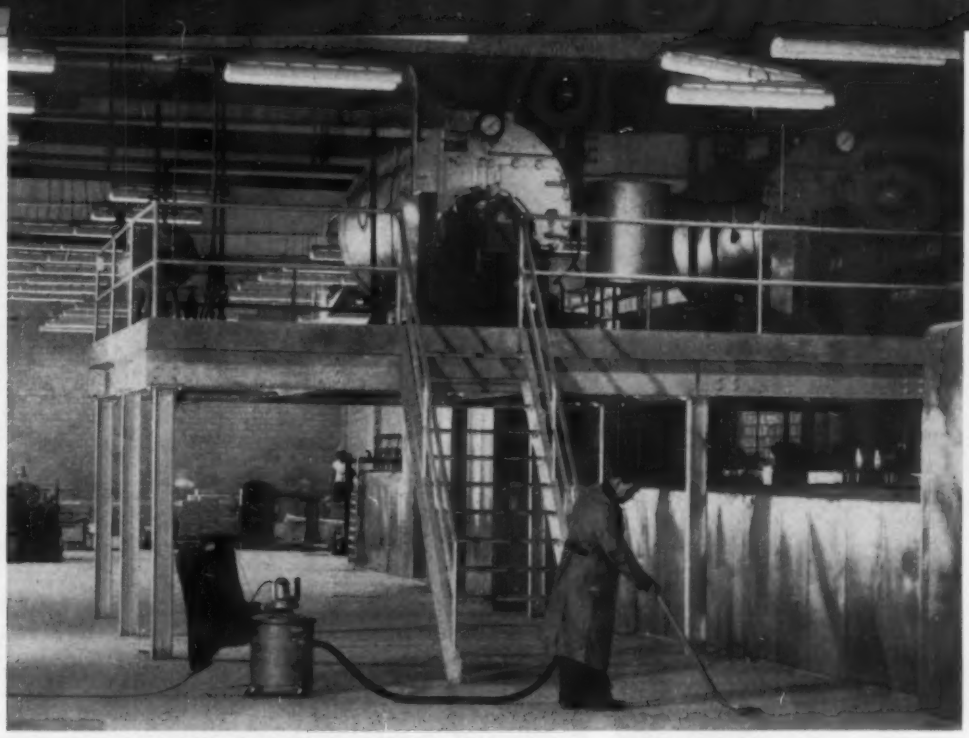
2 CONSTANT temperature and humidity conditions in the air conditioned materials storage and mixing rooms assure accurate weighing of materials. Special suction duct at hopper level is shown through the door

WHEN the A. O. Smith Corp. built its eastern electrode plant at Lancaster, Pa., for producing coated welding rod, desirable features of the firm's Milwaukee plant were incorporated in the new one. High on the list were the heating, ventilating and air conditioning systems.

The new million dollar plant itself is a one story rectangular building. An office and locker room area at the forward end occupies 6 percent of the total 44,000 sq ft of floor area. A small laboratory is near the offices. The manufacturing area consists of three main divisions. The first is a materials receiving and storage room; the second is a smaller mixing room; the third and largest part is a manufacturing and finished materials storage area.

Humidity Control Essential

Coatings for welding rod are made according to many different formulas, depending upon the application. One



3 TWO PACKAGED steam generators supply steam to air conditioning units, as well as to the drying ovens below the platform

systems which maintain a positive air pressure indoors

of the problems in preparing coatings to meet these formulas is that of mixing the various ingredients to the exact proportion necessary. Many of the ingredients are minerals and are not hygroscopic, while others are cellulosic and very hygroscopic.

Although the mineral substances can be weighed with accuracy, with changes in humidity the weights of the cellulosic substances vary, depending on their moisture content. For this reason, it is important that the humidity be controlled in the materials storage room to provide a uniform moisture content in the cellulosic materials before they arrive at the mixing room scales.

It was found more practical to thus control moisture content in the rooms than to dry the materials in a dryer. Therefore, an air conditioning system was installed in the mixing room to maintain year 'round constant temperature and humidity conditions.

The materials storage room is completely air conditioned with a direct expansion system and one air conditioning unit, together with two steam type humidifiers in the room but external to the air conditioning unit.

Positive Air Pressure

Positive air pressure in this space prevents the infiltration of outdoor air when materials are received. It also prevents dusty air from entering the room from the adjacent mixing room through a necessary conveyor opening in the partition.

A static pressure regulator regulates the operation of the outdoor and return air dampers on the air conditioning system to always maintain a pressure in the materials storage room slightly above atmospheric pressure.

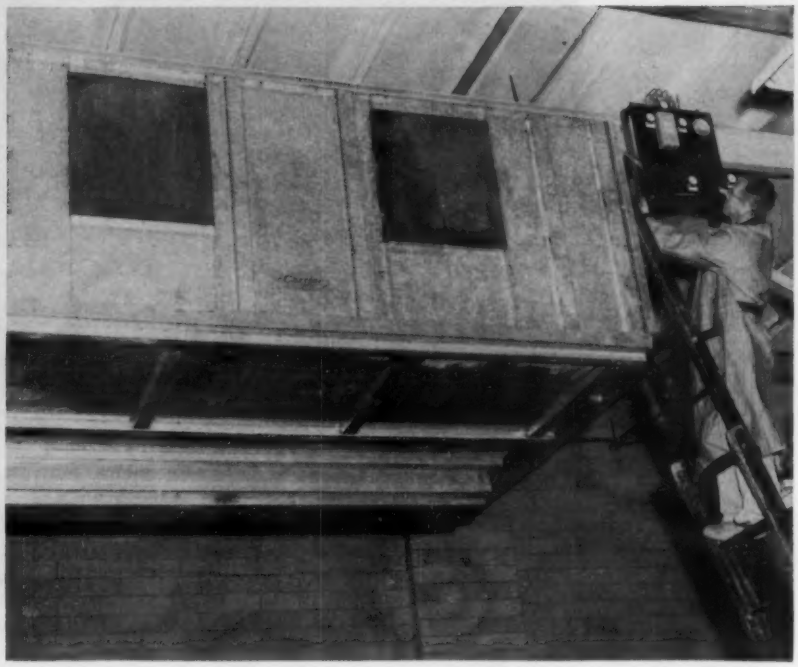
In the mixing room, the problem is primarily one of dust removal before the dust seeps out into the other areas. Dust is removed at the mixing hopper by means of a special suction duct at the bag level, shown in Fig. 2.

Provide Uniform Temperatures

In the manufacturing area of the plant, the primary problem was that of controlling temperature in the space. Windowless, except for the offices, the plant is constructed to house two large conveyor type ovens. With the heat given up by the electrode baking ovens and other heat producing equipment, the temperatures within the manufacturing area would build up to an intolerable degree without an adequate ventilation system. Since it was desirable to provide uniformly comfortable working conditions for the employees, it was necessary to install a mechanical supply of air and a mechanical exhaust air system.

The offices and locker room are heated by a forced circulation hot water heating system in two con-

4 THIS 150 FT BAKING OVEN has six control zones for regulating air distribution, humidity, and temperature



5 FORCED AIR distribution maintains a slight positive pressure in the plant to minimize infiltration of dust

exhaust air, as well as intake air, is treated

trolled zones with baseboard type radiation around the outside perimeter. Water for the heating system is heated by two water heaters which are made by the company.

The laboratory and office lobby are heated by individually controlled force flow convectors.

Employee lockers are ventilated by an exhaust system arranged with ductwork below the lockers, drawing air through the lockers and finally discharging it through a fan to the outdoors.

Ventilation System and Controls

Incoming air is filtered to remove all possible contamination — this despite the rural location of the plant. Air that is exhausted is washed to remove any possible dust. This adds to the insurance that all outside air will be less dusty before being admitted to the plant.

In the mixing room, a roof ventilator exhausts a constant quantity of air. This air is made up through conveyor openings in the partitions between the mixing room and the storage room, and between the mixing room and the manufacturing area. The amount of exhaust is determined by the size of these openings, so that a minimum of air flow from the other rooms to the mixing room is obtained at all times.

In the manufacturing area, three large blower type ventilating units provide heating when necessary, and provide a minimum amount of outdoor air to make up for combustion air required for the ovens. The units also mechanically introduce large volumes of outdoor air for temperature reduction within the plant when necessary.

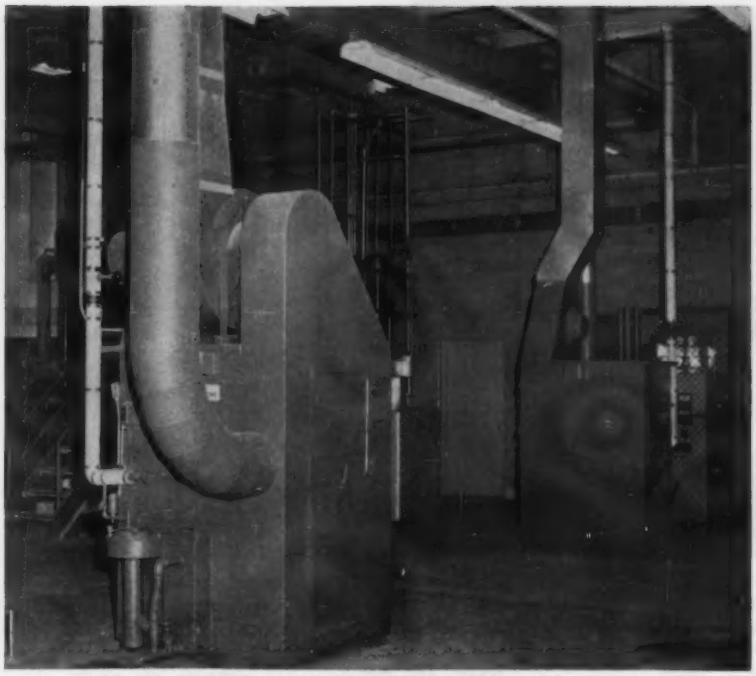
Along with this, four large roof ventilators over the ovens remove heat as quickly as possible from the warmest areas. Here, again, a static pressure regulator maintains a positive pressure in this part of the plant.

The automatic control system controls room temperatures by means of a room thermostat to pilot the discharge air temperature controller, which regulates an automatic steam valve supplying the coil in the supply air unit.

The discharge air temperature, therefore, is varied to meet the demands of the room thermostat. The outdoor supply and return air dampers on these units are regulated by means of a supersensitive static pressure regulator to maintain a slight positive pressure, as compared with the outdoors.

How Roof Ventilators Operate

The roof ventilators are equipped with motor operated dampers. The positions of these dampers are con-



6 EXHAUSTED AIR is washed in equipment like this to remove any dust before the air is released to the outdoors

to remove dust

trolled by means of room thermostats set slightly higher than the room thermostats which regulate the supply units. The controls function as follows:

Starting with the cold room, the room thermostats cause the steam valves to open to provide heat. As the room temperature approaches the setting of these thermostats, the steam valves modulate toward the closed position. As the baking ovens are put into use and provide a further heat gain, the temperature in the room rises above the setting of the thermostats controlling the supply air units. At the same time, the steam valve closes to a minimum position to maintain a predetermined minimum discharge air temperature.

Upon a further rise in the room temperature, the roof ventilators start. As the temperature rises still further, the dampers modulate to a wide open position, until they are exhausting 100 percent of their capacity.

During this time, the roof ventilators open to exhaust more and more air. The static pressure regulator senses the difference in the pressure between the room and the outdoors and automatically opens the outdoor air dampers on the supply air units and closes the return air dampers to admit up to 100 percent outdoor air.

If the ovens are shut off and the temperature drops, the sequence is reversed, with the automatic dampers in the roof ventilators going to a closed position, at which point the fans shut off.

Air From Ovens Heats Space

By another arrangement, warm air is taken off the ovens. Through a Y connection with the automatic dampers, this heated air can either be diverted into the manufacturing space or to the outdoors, depending upon the setting of another thermostat. This arrangement saves fuel when the outdoor temperature is so low that the heat losses of the building are greater than the heat gain within the building.

The entire roof of the plant was sprayed with aluminum paint to reduce the heat gain due to sun effect.

Packaged Steam Generators

Steam is supplied by two packaged steam generator units, mounted on a platform over the ovens to save floor space. These boilers are used not only for supplying steam to the ventilators and the air conditioning units, but also furnish steam to the ovens, where the drying process requires the addition of moisture to regulate the rate of drying the electrodes.

The steam boilers are shut off and the ventilating systems also are cut off during off-periods in the plant.

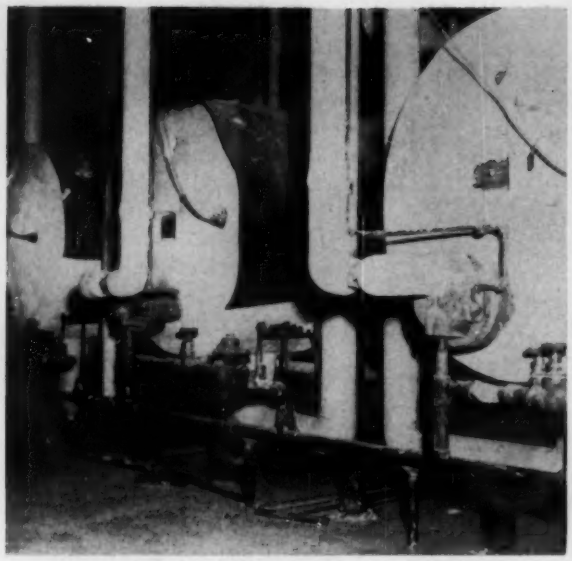
One unit heater of the projection type is installed in the manufacturing area and is connected to another water heater. This system operates only to maintain off-period temperatures in one part of the manufacturing area.

LP Gas Is Fuel Used

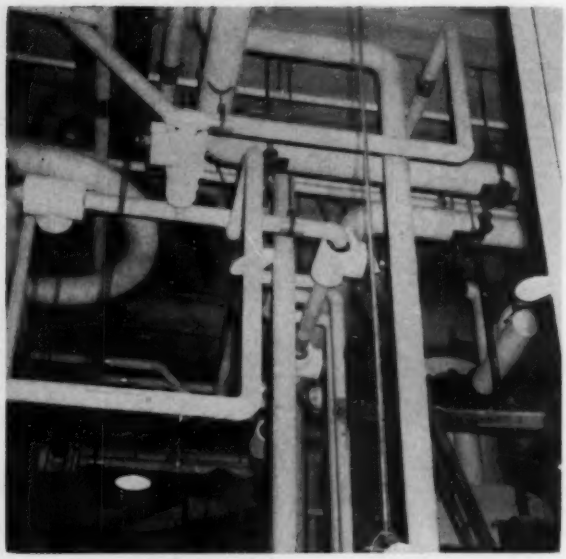
Liquefied petroleum gas is used for fuel for both the baking oven and for heating. The gas is stored in an 18,000 gal tank outside the building.

Flexible Temperature Control

Altogether, the heating, ventilating and air conditioning system gives adequate flexibility of temperature control in all areas of the building, and maintains necessary low humidities. The system also reduces the amount of dust in an inherently dusty operation, and provides adequate ventilation for the employees and adequate air for processes. At the same time, operating costs are kept low.



THESE HOT WATER SUPPLY GENERATORS for domestic hot water are located on the seventh floor. Both the seventh and 36th floors are devoted primarily to machinery. Protective covers on newly applied insulation were used during final stages of construction



HERE ARE SHOWN the main steam loop (upper left), a portion of the deaerating heater (right background), return condensate lines from the heating system, boiler feed lines from deaerating heater, and the soft water make-up line to the deaerating heater, all in the fourth basement

Boilers With Summer Peak Load

. . . require special attention to insulation of hot equipment

BOILERS that carry their light load in winter and their heavy load in summer constitute one of the many unique features of the new 40 story, $25 million Republic National Bank building in Dallas, Texas, according to the Magnesia Insulation Manufacturers Association.

The boilers operating in reverse of normal seasonal trends are on the fourth basement level. In the fifth underground level or sub-basement are the reasons for this contra-seasonal operation: two steam turbines, each driving a 936 ton centrifugal refrigeration compressor, which in turn serve the air conditioning system. While building heat and other boiler services could be supplied with a fraction of the rated boiler capacity, the air conditioning system requires the two 2 drum, bent tube, natural gas fired steam generators, each rated at 25,000 lb per hr.

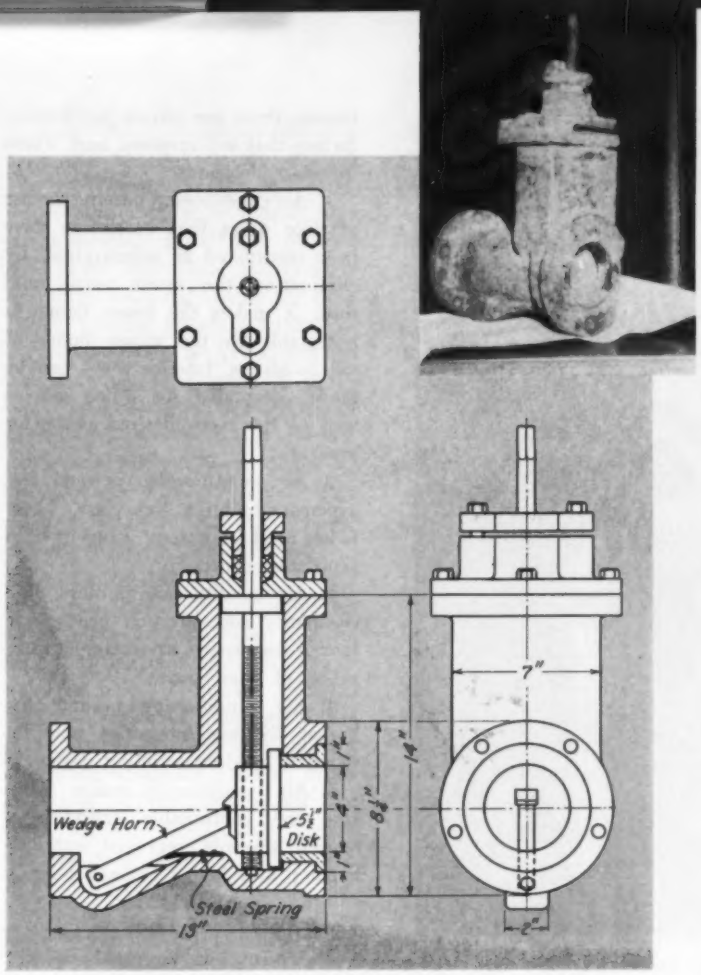
This added steam generating capacity, plus the fact that it operates at peak load in hot weather, makes insulation of hot piping and equipment especially important. In the fourth and fifth basement utility rooms, insulation must not only conserve heat and assist in efficient steam distribution but also must help maintain comfortable workroom temperatures. Because of the dual-purpose conditioning system throughout the building, insulation of hot surfaces is essential to guard against heat transfer to the cooling equipment.

Steam is delivered to the turbines at 398 F and 225 psig. Each turbine develops 950 brake hp at 4050 rpm. The two compressors cool 3000 gal of water per minute from 50 to 42 F. Three heating and cooling systems serve the building: a conduit system carrying warm or chilled water for the periphery offices of the tower floors, interior zone units for each floor of the tower, and separately controlled dehumidifiers for the lower banking wing.

Condensers, feedwater heaters, boiler feed pumps and flash tanks are insulated with 2 in. thick magnesia blocks, laced in place with galvanized hardware cloth and finished with a ½ in. thick layer of asbestos cement troweled to an even surface.

High and medium pressure steam piping, meaning all piping operating from 75 psig up, has nominal 2 in. thick sectional insulation finished with pasted canvas. All other steam piping, including drip, return and pumped condensate lines, has nominal 1 in. thick insulation.

The boiler breeching and other connections to boiler outlets are insulated with magnesia blocks 2 in. thick applied over V rib expanded metal lath. The blocks are finished with a ½ in. layer of hard asbestos cement.



THIS OLD SINGLE DISC valve has several unique features, including an inside screw gate

Diggers Discover Antique Valve

By Bill Dopp

Buried for years under layers of fill, this unusual old valve, part of an early district heating system, came to the surface when a ditch was opened in Milwaukee last summer

WHEN YOU BEGIN to dig in the center of an old city there's no telling what you're likely to bring up. Recently, a contractor made an interesting discovery while opening a ditch in Milwaukee for the Wisconsin Electric Power Co.'s heating division. On one bite the clamshell brought up an old manhole cover. On the next, it lifted to the surface an unusual cast iron valve, weighing 50 lb.

Investigation revealed that this valve had been installed about 1882 in what was then a new high pressure heating system by the original district heating company. The steam lines operated at 80 psi. The pipe was of light steel, wrapped in asbestos paper and encased in wood staves held in place by heavy wires. Screwed couplings connected the pipe except at the valves, where five bolt flanged joints with asbestos gaskets were used.

But after two and a half years of operation, financial losses through over expansion and mechanical troubles, such as leaking expansion joints, valves and line joints and unreliable regulating valves, caused the company to close down on a cold February day.

The piping system was left in the ground. During the following years, it was covered with many layers of fill. From time to time, sections of the pipe were uncovered, but this is the first valve or fitting discovered.

The valve is a 4 in. single disc, inside screw gate of unknown make. It has several unique features, the principal one being a wedging horn hinged in a channel on the bottom, inside the valve. This horn engages the boss on the back of the disc, forcing the disc up against the seat ring. The boss carries the thread for the stem, which appears to be of steel.

Under the wedging horn, a steel spring bolted to the bottom helps to raise the horn, and thereby assists in opening the valve. The disc is brass faced with a pressed ring. The seat ring is ell shaped, pressed into the body from the outside of the short end, the ell forming a seating surface for the line gasket. The bonnet is square and is provided with a bolted stuffing box.

Here's an "Overall Look"

Air Conditioning Multi-Story Buildings

• Changes in practice in the air conditioning of new and existing multi-story buildings, as well as some of the problems, are discussed here.

By P. B. Gordon

Vice President,
Wolff & Munier, Inc.
Engineers and Contractors

THE ART of installing air conditioning systems for multi-story buildings has changed considerably during the past eight years.

Year-round conditioning for large buildings has been shifting from that of the very occasional luxury application during the 1930's to a strong demand situation that now exists in many cities.

Beyond these trend and demand factors, there are certain justification factors that are involved here which influence decisions.

1. Air conditioning permits the use of floor areas that heretofore have been considered as submarginal. By eliminating the street noises and dust, it makes the lower floors as acceptable as the upper floors of tall buildings. Interior areas can be made acceptable for office use as well as the more desired perimeter areas.

2. Air conditioning permits less expensive building floor plans. There is less need for narrow wings or light ventilation courts.

3. Air conditioning permits high occupancy concentration per square foot of floor space, or maximum utilization of floor space.

4. Air conditioning permits the higher lighting intensities now favored in modern building design.

5. Air conditioning makes available the controllable environment tending towards improved work efficiency and better housekeeping.

First Period of Change

The histoy of the methods and techniques used to air condition tall buildings during the period of change can be divided into two general time periods: (1) those methods that were in common use before the middle 1930's, and (2) the more popular methods developed since the middle 1930's.

The early period approach to the occasional problem of providing air conditioning for a multi-story building used the equipment and methods available during that time — methods then available to provide conditioning for industrial plants, movie houses and department stores. These methods mainly involved the large space technique, handling large quantities of conditioned air introduced directly into the space to be served.

During this early period, the refrigeration effect generally was provided by an ammonia or carbon dioxide plant, though centrifugal machines became popular during the latter part of that period for loads over 100 tons of refrigeration capacity. These plants circulated brine

or chilled water to the air handling apparatus to provide the cooling. The development of compact lightweight refrigerating equipment, simple automatic refrigerant controls and direct expansion refrigeration equipment occurred during the early 1930's. Cooling towers for condensing purposes were not yet in common use. Even large refrigerating plants used city water or well water for condensing purposes, and city governments were not yet aware of the inordinate drain on municipal water supplies to be created by the expanding air conditioning industry.

The cooling and dehumidifying of air during this early period of air conditioning involved either the use of a spray dehumidifier — air washer — or a pipe coil bunker installed in a spray washer. Lightweight finned heat transfer surface designed for circulation of chilled water or direct expansion of refrigerant did not enter the air conditioning picture until the early 1930's.

Second Period Advance

In addition to these two important developments, the more important changes of the second period can be grouped as follows:

1. *Changes that have improved the distribution of air conditioning effect.*

These involve improvements for more effective distribution of conditioning effect to remote spaces — development of self-contained units, local terminal air handling units supplied by all-air single ducts, all-air hot and cold dual ducts, or air and circulating water, wherein the air supply system from the central apparatus involves low velocity or high velocity air distribution.

2. *Changes that have improved reciprocating refrigerating compressors.*

Advances during recent years have tended toward higher speeds, by the use of direct drives — up to 1750 rpm — resulting in more compact units and smoother running equipment. This improvement permits installation of local refrigeration apparatus from ½ hp to several hundred horsepower on the upper floors of multi-story buildings.

3. *Changes that made the use of steam for refrigeration power feasible.*

Steam engine driven reciprocating apparatus for ammonia and carbon dioxide refrigeration plants and steam turbine driven centrifugal apparatus were available during the 1920's. Though steam jet water vapor refrigeration apparatus enjoyed a period of popularity during the early 1930's, this development was not well received at the time because of high water rates and correspondingly large cooling tower apparatus requirements. In recent years, however, modern absorption refrigeration equipment has become available. These machines use steam at low operating pressures with comparatively good economy, and therefore rather low total condensing requirements. At the present time, turbine driven centrifugal machines and modern absorption machines provide equipment that permits the use of steam as a source of power where steam rates and facilities are competitive with electric power rates and facilities.

4. *Changes that have integrated ceiling construction with air conditioning distribution.*

At present, considerable interest is displayed in the complete ceiling that provides for overall environmental control — that is, acoustic treatment, modern lighting and thermal environment. Arrangements are now available that permit integrating ceiling diffusers, perforated panel outlets, or panel ceilings for heating or cooling, into a modular ceiling arrangement.

Distributing the Effect

The most serious application problem associated with multi-story air conditioning concerns the most feasible method — as to engineering, economics and practicality — of providing for the distribution of the air conditioning effect to the multi-stories, generally on a multi-room or multi-zone basis. This problem is complicated by the complexity of central systems vs. units, high velocity vs. low velocity duct distribution systems, air ducts vs. water piping along with complexity of apparatus, controls, and other equipment.

There are other important problems — the method of supplying refrigeration, the location of the cooling tower, use of steam or electric power for the refrigeration plant; but the problem involving the major study and influencing the largest amount of overall building investment will revolve around the manner of distributing the air conditioning effect.

As of the present, the more popular approaches may be summarized as follows:

Unitary Methods

1. Room Units. Self-contained air cooling units of 1/3 to 1½ ton capacity are usually provided with an air cooled condenser. The unit is generally in or in front of the room window. Units may be provided with hot water or electric air heaters.

2. Self-contained Units. Self-contained air cooling packages of 2 ton to 25 ton capacity which include refrigeration apparatus with fans, motors, air filters, heating coils and automatic controls. These are generally used to serve small office groups or an entire office floor. Units may be provided with low velocity duct distribution to remote spaces. Condensers are usually water cooled though larger sizes may be associated with an evaporative condenser. Steam or hot water coils are generally included for air heating and dehumidification control.

Central System Methods

These usually involve a central system refrigeration plant distributing chilled water to apparatus rooms or local terminal units. Steam or hot water is also furnished to apparatus rooms or terminal units for heating.

1. *All Air Distribution*

a) *Single Duct — Low Velocity*

These systems may be arranged with central apparatus rooms serving an entire building or section of a building, or may be arranged with

In the short history of air conditioning, methods have changed considerably, stimulated by active demand.

local apparatus rooms serving smaller areas. Distribution system may supply conditioned air to a large area or a single zone at a single temperature under control of a single thermostat or a series of averaging thermostats without zone control or individual room control.

If additional controls are desired, this method of distribution may be supplemented by either zone reheaters, individual room reheaters, zone volume controls, individual room volume controls or a combination of these arrangements under control of local room or zone thermostats.

Low velocity ducts are generally accepted in the industry as those constructed in accordance with ASHAE Recommended Gages and Construction, for velocities from 800 to 2000 fpm.

b) *Single Duct — High Velocity*

At the present, so-called high velocity systems generally distribute air at velocities ranging from 2500 to 4000 fpm, and usually with temperature differentials for cooling in the order of 30 F between the supply air and room air rather than the conventional 15 F to 20 F temperature difference. This combination of high air velocity and large temperature difference of course reduces the sizes of the ducts.

These systems require air supply diffusers which distribute the air satisfactorily at these high temperature differentials, and which are used in combination with sound attenuating devices in or near the room to reduce air and fan noise. These sound attenuating boxes are combined with control valves to permit temperature control for small areas.

c) *Dual Duct — Low Velocity*

Air is distributed to the conditioned spaces through two parallel ducts operating at two temperature levels. Air is supplied to the individual spaces through a mixing arrangement with the quantity of heated and cooled air controlled by variable dampers.

d) *Dual Duct — High Velocity*

This arrangement is similar to the dual duct low velocity systems except that smaller ducts will result from high velocity distribution and larger supply air temperature differentials.

Dual duct high velocity air distribution may supply ceiling diffusers similar to the single duct high velocity type with sound attenuating boxes or may supply mixing boxes and air diffusers designed for "under window" installation.

"Under window" boxes may use some local induction of room air to reduce quantity of air transported through the distributing system.

Control is provided by regulation of hot vs. cold dual duct air quantities.

2. *Terminal Units with Primary Air Distribution*

a) *Induction Unit — Low Velocity*

All cooling is generally provided by the supply air transported through the duct system at high temperature differentials. The ratio of primary air to induction air depends on the static pressure available at the unit. Induction units are generally provided for each room module and are equipped with either steam or hot water coil heating for reheat control in summer and to supply building heating in winter.

Control can be provided by a manual air damper, an automatic air damper or an automatic coil valve.

b) *Induction Unit — High Velocity*

The unit located in each module includes primary air supply from a central source, an induction arrangement to recirculate room air, a water cooling or heating coil treating recirculated air and a sound attenuating box. The primary air supplied to the unit satisfies the ventilation requirements, dehumidification, provides power for the induction effect and provides for selective control flexibility. The water coils are served by a central distribution system with both primary air temperature and water temperature under control to make available at each module selective control flexibility. Individual unit control is generally by an automatic control valve for each water coil.

c) *Fan Coil Unit with Primary Air*

These units are within each module and include a water coil, air filter, fan and motor. Primary air supplied to a fan coil unit may be distributed by means of low velocity ducts or high velocity ducts. Primary air is provided to satisfy ventilation requirements, dehumidification, and to provide for selective control flexibility.

d) *Terminal Units without Primary Air*

Fan coil units are installed without direct connection of primary air to units, so that units simply recirculate room air. Primary air may be supplied to the conditioned spaces by means of a separate duct system for ventilation, dehumidification and selective control requirements. Another modification involves drawing outdoor air for ventilation directly into terminal units through building wall slots.

3. *Panel Type Ceilings in Combination with Air Distribution*

Several panel ceiling arrangements are available that integrate complete ceilings with special panels used for heating and cooling. One arrangement uses circulating water to heat or cool the panel while another arrangement uses the ventilation air as the panel heating or cooling medium. Either arrangement utilizes panels to offset a fraction of the sensible heating or sensible cooling load with the ventilation air supplied directly — or through the panel for air panels — handling the ventilation require-

ment, the dehumidification effect as well as some part of the direct load.

What System to Use?

This summary of "distribution methods" does not discuss the merits or advantages of the several arrangements, nor is it intended to provide such a discussion other than to set forth some of the more pertinent considerations that affect reasoning or justification when determining the "*most* feasible" method.

Some of the considerations that influence space, planning, installation and operating problems and costs:

1. *Loss of building floor space.*

a) Location and size of apparatus rooms required.

b) Floor space used by ducts and piping.

c) Ceiling space used by ducts and piping.

2. *Most effective manner of transporting Btu's.*

a) Use of air ducts vs. water piping, also use of two thermal circuits — air and water — vs. one thermal circuit — air.

b) Use of high velocity ducts vs. low velocity ducts.

c) Use of high temperature differential vs. normal temperature differentials.

3. *Flexibility and control.*

a) Providing for selective room or module control.

b) Handling shifting perimeter load.

c) Handling changeover from cooling to heating.

d) Providing for relative humidity control.

4. *Air cleaning.*

a) Effectiveness and location of outdoor air filters.

b) Effectiveness and location of return air filters.

c) Arrangement to service filters.

5. *Noise and vibration.*

a) Economy of high velocity distribution vs. cost of adequate sound attenuating devices.

b) Occupied spaces noise level — with systems in operation — as compared with background noise level.

6. *Servicing and operating problems.*

a) Amount and location of apparatus requiring routine maintenance, inspection and repairs.

b) Coil cleaning requirements.

c) Filter servicing.

d) Stability of automatic devices and controls.

7. *Economy of operating refrigeration plant.*

a) Quantity of outdoor air supplied for ventilation.

b) Quantity of primary air supplied to remote terminal units.

c) Method of providing cooling by use of outdoor air during midseason.

d) Excessive dehumidification resulting from the use of high temperature differential-low air quantity systems.

8. *Installation complications—Existing buildings.*

a) Adequacy of existing perimeter heating system.

b) Method and scheduling for removing heating system and installing new perimeter system.

c) Extent of disturbance to building occupants and cost of overtime operations.

Three Factors Are Involved

The particular problems associated with large buildings are such that three major factors will generally influence an evaluation of these factors.

1. How important is the "building skin" load, and is it important to separate the perimeter area from the interior area? The interior spaces of a modern building require cooling at all times due to the constant load created by the occupants and lighting and the absence of exposure load. A great number of these considerations hinge on the relative importance of the perimeter load as compared with the interior load.

2. How important is "control"? Must there be selective room or modular control, or will zone or area control be acceptable? Further, how flexible must the system be to provide the desired control and to automatically meet the changing load?

The changing load consideration and the inherent flexibility and controllability of the system are of extreme importance at the time of weather change — shift from a heating day to a cooling day, or a heating morning to a cooling afternoon. This consideration is also of importance when cooling is required on one side of the building as a result of sun effect, plus lights and occupancy, while heating is required on other sides because of outdoor temperature transmission losses exceeding heat gains.

In this regard, as more and more people live and work in fully air conditioned buildings, the demand for more accurate control becomes more pertinent. For the early systems, often an approximation of control appeared to be acceptable as it was then believed that any summer air conditioning was better than none. Today, and more so in the future, this concept will no longer hold. The modern tendency is toward accurate control at all times — cooling days, heating days and in between days.

3. How much building space will the proposed system use for the installation of ducts, piping, equipment and the rest?

The entire problem of space, effective distribution, flexibility and control is concerned with high velocity vs. low velocity distribution, all-air vs. air-water distribution, and low vs. high temperature differential distribution.

To justify any small duct systems with possible savings in space, construction costs and duct and insulation costs, one must be prepared to accept higher costs for diffusers, controls, valves, mixing boxes, fans, etc.

Undoubtedly, many new and improved devices and arrangements will be developed in the future, for an alert industry would not discharge its responsibilities if it were unable to continually develop improved solutions for such problems. However, it is believed that most improvements in the immediate future will be mainly those of details rather than revolutionary deviations from the present-day approach. The trend will be toward the improved system capable of the utmost in performance.

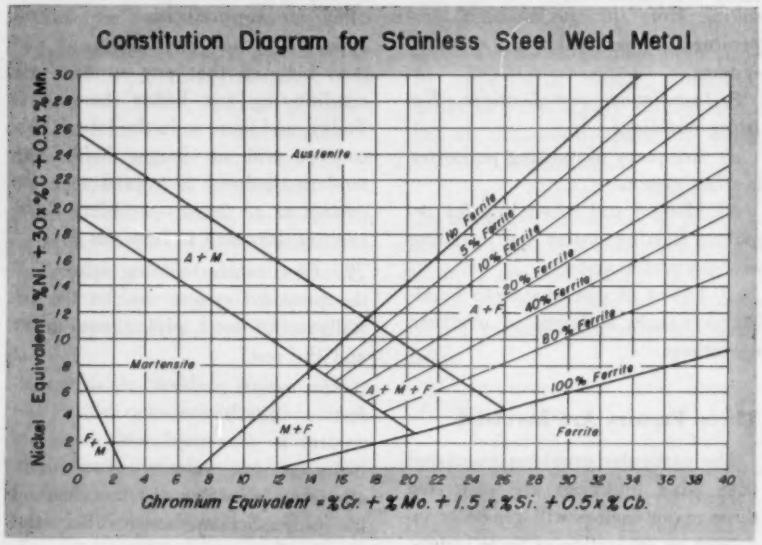
Abstracted from a paper presented at the annual meeting of the American Society of Mechanical Engineers held recently in New York.

Preventing Weld Cracks in 1100 F Stainless Piping

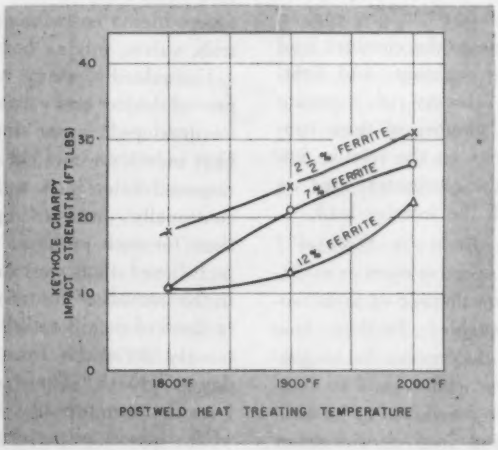
. . . new welding procedure for type 347

By R. M. Curran and A. W. Rankin

Large Steam Turbine-Generator Dept.
General Electric Co.



1 EFFECT OF THE COMPOSITION of stainless weld metal on its structure is shown in this diagram after Anton L. Schaeffler



2 EFFECT OF AGING TREATMENT on the room temperature keyhole charpy impact strength of type 347 weld deposits is shown here

THE PROBLEM of cracking in pipe welds recurs again and again. This is especially true with austenitic stainless steel piping. To prevent such cracking, an investigation of the embrittlement process was made recently. As a result, a new welding procedure has been developed by which type 347 welds can be made insensitive to embrittlement at 1100 F and above.

The electrode used has a low ferrite content — 1 to 4 percent — and is balanced chemically as shown in Table 1. Highly restrained austenitic weldments made with such an electrode, if heat treated rapidly at 1925 F, have great resistance to embrittlement ordinarily caused by long exposure to high temperatures. The investigation also showed that low ferrite welds heat treated at 1925 F possess long time, high temperature rupture strength equal to that of type 347 base material and type 347 welds made with the usual commercial compositions. However, complete proof of success must await the results of years of service at 1100 F and above.

What Causes Cracking?

Cracking in austenitic stainless steel piping welds is usually caused

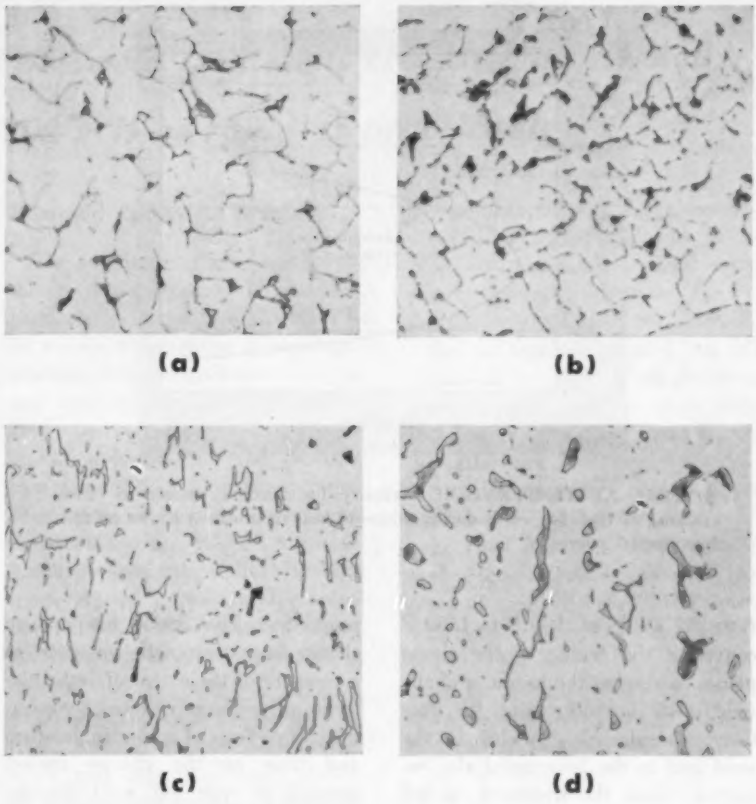
TABLE 1—SOUND WELDS can be produced in type 347 stainless steels, using an electrode with 1 to 4 percent ferrite and balanced chemically as shown below.

Chemical Composition, percent Deposited Weld Metal	
Carbon	0.07 - 0.10
Manganese	1.50 - 2.50
Phosphorus, max.	0.04
Sulfur, max.	0.03
Silicon, max.	0.05
Chromium	18.5 - 20.5
Nickel	9.0 - 10.5
Columbium	0.60 - 0.90
Silicon-carbon ratio, max.	5/1
Ferrite content percent (Calculated from chromium—nickel equivalents)	1 - 4

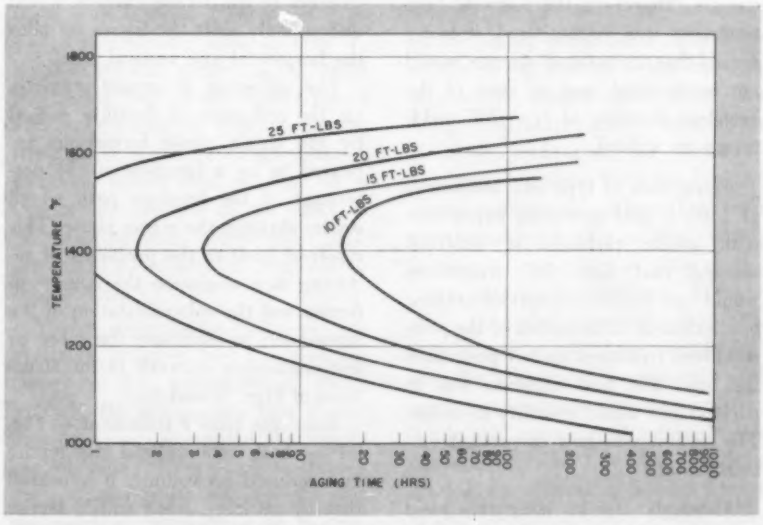
by either: (1) a greater notch sensitivity of the austenitic steels; (2) by a slower relaxation of residual welding stresses; (3) by excessive thermal expansion stresses; or by a combination of these factors. In addition, the ductility of these welds decreases in time at the operating temperature due to the transformation of austenite to ferrite in the deposits themselves. This transformation, known as sigma phase or sigma transformation, is so called from the *C* shaped curves representing the time required at constant temperature for the transformation. While the first three causes can be minimized and perhaps eliminated by design and erection modifications, the elimination of the sigma formation appeared to be a more difficult problem. It appeared to be one whose effects would become more pronounced as operating temperatures reached and exceeded 1100 F.

Experience with sigma embrittlement and cracking in the operation of 10 large 1050 F steam turbines proved invaluable when design was started on the first 1100 F unit. On this, as on the 10 early 1050 F units, austenitic stainless steels were used.

On the 1050 F units, cracking occurred in and adjacent to the welds. The welds were made with type 347 electrodes, with 8 to 10 percent ferrite content and no preheat. All the piping and major turbine parts were of austenitic stainless steels 316, 321, and 347. Most of the piping welds on one unit received 1600 F postweld treatment, but some on that unit and all on the others received no postweld heat treatment.



3 PHOTOMICROGRAPHS — 1000X — show the structure of type 347 weld deposits (a) as welded, (b) after aging at 1200 F, (c) after aging at 1350 F, and (d) after aging at 1650 F. Photos slightly reduced



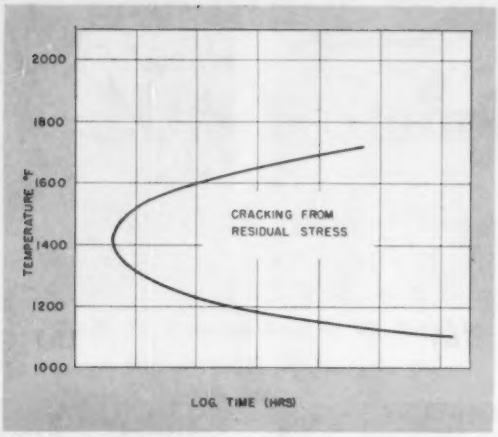
4 THE EFFECT OF AGING postweld treated type 347 stainless steel weld deposits on impact strength is shown here

Composition, Heat Treatment

After encountering considerable weld bead and crater cracking in these early welds, it was discovered that higher chromium and lower nickel contents in the deposited weld metal produced a greater resistance to cracking. Metallographic studies of the improved weld metal showed small percentages of ferrite in the austenitic matrix. See Fig. 1.

It's an accepted fact that such weld deposits are immune to cracking during welding. And although weld metal compositions of type 347 are designed to contain ferrite, the effectiveness of ferrite in preventing cracking is not completely understood yet.

However, postweld heat treating of



5 TIME AT TEMPERATURE necessary for residual stresses to cause cracking of type 347 welds during postweld heat treatment is shown by this hypothetical curve

type 347 welds at 1200 F to 1500 F converted the ferrite to the sigma phase, increasing the hardness of the weld metal but decreasing the ductility. Considerable cracking in the weld and in the base metal also occurred. Since the treatment caused the ductility to decrease, instead of increasing it as in welds for ferritic steels, the sole benefit seemed to be the relief of the residual welding stresses. Therefore, the postweld heat treatment was discontinued, it being agreed that the residual stresses would not be harmful, and in view of the excellent ductility of type 347 weldments as welded.

Aging tests of type 347 weldments at 1100 F and operating experience with steam turbines at 1050 F showed that type 347 weldments would lose ductility in service at these temperatures. Elimination of the postweld heat treatment merely postponed the loss. The first question was to what extent would ductility decrease. The second was how to prevent embrittlement.

Although tensile strength, yield strength, rupture strength, and creep strength are directly convertible to allowable design limits, it is difficult to decide upon what basis satisfactory ductility limits can be set. So as much ductility as possible is provided without undue sacrifice of tensile properties. The room temperature charpy impact strength was used as a measure of the extent of embrittlement of welds at elevated temperature. The effects of aging temperature and time on the charpy impact strength of type 347 weld deposits are given in Fig. 2. This figure is only schematic because of the limited data and because it is peculiar to each particular composition, as changes in the ferrite content would undoubtedly shift the figure on both the horizontal and vertical axes.

The reduction in impact strength, i.e. the reduction of ductility caused by the sigma phase formation, appeared to be a function of the percentage of the fracture path which occurs through the sigma phase. This resolved itself to the problems of reducing to a minimum the volume of ferrite and the spheroidization of the remainder, to eliminate the more or less continuous network in the structures of Figs. 3a and 3b.

Since the 1650 F treatment — Fig. 3d — both spheroidized the ferrite and reduced its volume, it appeared that by utilizing a low initial ferrite content together with a suitable heat treatment, a minimum of ferrite would be present to convert to sigma; and the ferrite would be essentially spheroidal in form so that its conversion to sigma would not cause any serious loss in ductility.

Test Hypothesis

In order to test the foregoing hypothesis, a number of type 347 welds were made with initial ferrite contents ranging from 2½ to 12 percent, with postweld treatments varying from 1800 to 2000 F, and with subsequent aging at 1350 F for 300 hours. The 1350 F was selected from previous data, which indicated this to be close to the temperature of most rapid sigma conversion. The keyhole charpy impact strength of all these welds was approximately 30 ft-lb after the postweld treatment but before the 1350 F aging treatment. The effect of the latter aging treatment on the impact strength is presented in Fig. 4. A type 347 weld with an initial ferrite content of about 8 percent and with no postweld treatment would drop in impact strength from an initial value of 30 ft-lb to 7 ft-lb when exposed to this 300 hour aging at 1350 F. The effects of the 1350 F aging are minimized by using the lower ferrite contents in conjunction with a postweld treatment at 1900 to 2000 F.

Also, a number of type 347 welds were made with a deposited ferrite content of about 2½ percent, and with a postweld treatment at 1925 F. To simulate the aging effects of many years at 1100 F, the welds were aged at 1200 F for periods up to 6400 hours.

Silicon-Carbon Ratio

While the foregoing tests demonstrated a means of minimizing service embrittlement, the use of such a low ferrite electrode involves the risk of cracking during welding if base metal dilution causes the weld deposit to become fully austenitic. It was known, however, that sound welds can be made in the fully austenitic 25 percent chromium, 20 percent nickel and 15 percent chromium, 35 percent nickel compositions by properly balancing the silicon and carbon contents. Accordingly, tests were conducted on three series of fully austenitic type 347 welds with varying silicon contents and silicon-to-carbon ratios. Sound welds were obtained as

". . . The danger of postweld treatment cracking is lessened if the heating above 1200 F is as rapid as practicable . . ."

long as the silicon-carbon ratio was five or less.

In the 25-20 and 15-35 compositions, and in the foregoing fully austenitic 347 welds, the silicon-carbon ratio was maintained at the desired low level by permitting carbon contents higher than in the standard 347 electrodes. Aging tests on the higher carbon, fully austenitic welds, however, indicated that the higher carbon content resulted in increased embrittlement tendencies, and that it would therefore be desirable to maintain the desired low silicon-carbon ratio by holding to a low silicon level rather than by using a high carbon content.

But since it would be impracticable to attempt to maintain a very low silicon content in the relatively large quantities of this electrode which would be needed, it was necessary to compromise somewhat on both silicon and carbon by permitting the silicon to go to 0.05 percent maximum, and by increasing the carbon maximum to 0.10 percent from its more usual value of 0.08 percent. The higher carbon content was considered acceptable for power station steam piping, since the atmosphere is not particularly corrosive. The columbium content was specified as 0.60 to 0.90 percent rather than the more usual specification of 10 times the carbon content. The contribution of columbium in high temperature applications is its improvement of rupture strength rather than its ability to stabilize carbides to resist corrosion. The final specification for the low ferrite electrode is given in Table 1.

High temperature rupture tests were conducted on these low ferrite welds with a 1925 F postweld treatment, using the Larson-Miller method of trading exposure time for temperature. The rupture strength of the low ferrite weld deposit is equal to that of the type 347 base material.

Postweld Treatment Cracking

The possibility of cracking during the postweld treatment still remained, particularly in the heavy sections to be welded. Quantitative data on such cracking is somewhat limited in scope and applicability. However, it has been observed that cracking of austenitic welds during the postweld heat treatment is accentuated rather than alleviated by slow heating, and that such cracking is generally intergranular, indicating failure at high temperatures. So the cracking seems due to the residual welding stresses rather than stresses caused by uneven heating.

While quantitative data on the relative rates of decrease of residual stress and rupture strength during the postweld treatment is not available for the complex residual stress pattern in welded joints, some data is available from uniaxial relaxation creep and rupture tests. The data from such tests at 1100 F on type 347 steel indicates that, at 1100 F, uniaxial residual stresses of the initial magnitude used in these tests would eventually result in rupture failure. Residual stresses in restrained welds, however, would tend to relax at a slower rate because of the effect of multiaxiality and, accordingly, failure would be expected at a somewhat shorter time.

While quantitative data is not available defining this point of intersection for temperatures above 1100 F, the observation that slower heating rates accentuate the cracking of type 347 weldments during the postweld treatment suggests that the point of intersection of the residual stress and rupture strength curves occurs at a minimum time at some particular temperature. It can be hypothesized, therefore, that a plot of cracking time versus temperature would be of the general shape shown in Fig. 5. This in turn implies that the heating above approximately 1200 F should be as rapid as practicable without introducing excessive stresses due to thermal differences.

Several highly restrained type 347 weldments subjected to the following postweld heat treating cycle were found free of cracking upon inspection afterward:

1) Heat to 1100 F at 300 F per hour.

2) Hold at 1100 F for 2 hours to permit temperature equalization and relief of the higher residual stresses.

3) Heat from 1100 F to 1925 F at 600 F per hour.

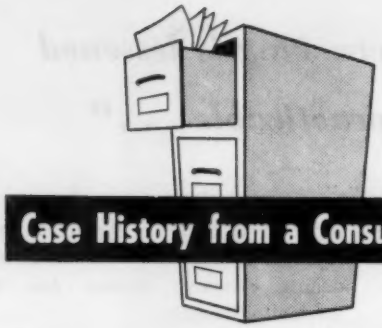
4) Hold at 1925 F for 2 hours for complete stress relief and ferrite solution and spheroidization.

5) Air cool.

Shop and Field Fabrication

The low ferrite welding electrode and 1925 F postweld treatment have already been used for the fabrication of the piping components in and for several power generation stations with satisfactory results. Some difficulties have been experienced with both electrode and postweld treatment cracking, but these have not been of major consequence. There has been some cracking during welding, which is not too surprising in view of the low ferrite level maintained. Further study is needed concerning the dilution effects of the base metal, and also the relation between base metal composition and electrode chemistry. While still more investigation of the characteristics of type 347 welds is needed, the difficulties have not been of sufficient magnitude to cast serious doubts on the practicability of the suggested procedure.

This is an extensive summary of a paper presented at the annual meeting of the American Welding Society. The references and several figures have been omitted because of space limitations.



Case History from a Consulting Engineer's Files

By C. T. Baker
Consulting Engineer

Operating Costs Can Be Cut

Proper maintenance saves heat in a large laundry, with the addition of a reducing valve, the installation of individual steam traps, and by the accurate measurement of boiler efficiency.

IN INVESTIGATING operating problems, whether in laundries, meat packing plants, hotels, or factories, I find that the sources of fuel and steam waste generally stem from the same cause. Such plants often lack an effective maintenance policy; no one person or group has been made responsible for maintenance. Too often the man in charge of the boiler plant and mechanical equipment "just hasn't had time."

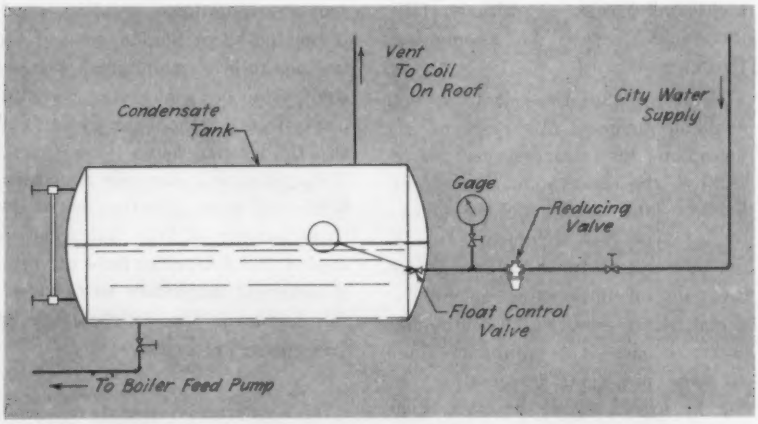
Boiler Setting Leakage Stopped

In one recent case, the unsatisfactory operation of a 300 hp water tube boiler supplying steam to a large laundry finally led to an investigation of the trouble. Natural gas was the principal fuel, with Bunker C fuel oil as a standby.

A flue gas analyzer connected to the last pass of the flue gas outlet read 5 percent CO_2. A second reading, with another instrument, gave the same value.

The search for the cause of the low CO_2 was short. Numerous cracks in the brick boiler setting were permitting large quantities of air to enter. The discharge temperature at the flue gas outlet was only 30 F above the temperature of the steam corresponding to its saturation temperature. This condition could be attributed to the leakage of large quantities of excess air into the setting, which cooled the flue gases. An immediate increase in CO_2 was registered after cracks in the brick work were closed.

A weekend shutdown of the boiler plant permitted an internal inspection of the baffles which controlled the passage of heated gases through and around the tube banks. Some disturbing conditions were uncovered. In many places, the baffles were completely gone. At other points, the breaks between joints were large enough to permit short circuiting of the flue gases direct to the stack. These faults accounted for an enormous waste of heat that should have been converted into steam. The plant manager, however, stated that the estimated cost of making repairs and



A PRESSURE REDUCING VALVE, installed on the city water line, enabled the float control valve to open and close according to make-up needs of the condensate tank

replacing missing baffles was more than they could afford to spend; so they would have to endure the losses until their business showed a decided improvement.

Reducing Valve Added

A 3 ft diameter × 6 ft long cylindrical steel tank in the boiler room collected hot condensate from several steam traps in the laundry, for use as feedwater. The flash steam was piped to a water heating tank in a penthouse on the roof of the building. City water was used for boiler feed make-up and its pressure at the collecting tank registered 110 psi.

A small float operated valve had been installed to control the admission of make-up water. Since the valve could not operate against the unbalanced pressure, it failed to prevent overflow, and there was a continuous waste of both heat and city water. As a result, the feedwater temperature seldom exceeded 115 F. This loss of heat and water had been going on for six years when a pressure reducing valve and gage were installed on the city water supply line, reducing the pressure to 20 psi. This enabled the float actuated valve to open and close in response to make-up needs and eliminated the waste of heat and city water. Arrangement of the reducing valve is shown in the accompanying illustration. Feedwater temperature now averages 175 F to 185 F, which represents a fuel saving of better than 5 percent.

Individual Traps Installed

Of the 50 steam traps installed in this plant, not one had ever been checked for leaks, nor had the pipe line strainers been removed for cleaning. One trap, opened at random, was found to be so completely out of order that it allowed steam to blow through continuously at boiler pressure. The strainer on the steam inlet of one of the traps was 90 percent clogged. Naturally, the laundry press connected to it was difficult to heat.

In some cases, one trap drained condensate from all the steam chests of a six or eight roll flatwork ironer. As a result, the rolls could not be heated properly, causing a reduction in weight of the materials handled and, inevitably, greater labor cost per unit of output. A single trap cannot be expected to drain quickly and completely more than one steam chest. The unsatisfactory arrangement was corrected by the installation of a separate trap of correct capacity for each steam chest.

A little sleuthing by regular maintenance personnel could easily have discovered and corrected this.

Draft Gage Relocated

A brick chimney, 140 ft high, supplied natural draft for the boiler in this plant. A draft gage was installed in the flue on the upstream side of the barometric draft damper. The plant engineer complained that regardless of how the damper was adjusted, it made no change in the draft gage reading. He reasoned erroneously from this that both the draft damper and the draft gage were out of order.

The draft gage was relocated in the flue between the draft damper and the breeching, as it should have been originally. The new location permitted the gage to accurately sense any change in the draft over the fire in the boiler.

No great engineering or managerial ability is required to correct such wasteful conditions as these. But vigilance is essential. Failure to properly maintain plant equipment leads to unnecessary operating expenses and high repair costs.

Jet Action of Blowdown Valve

. . . can damage piping

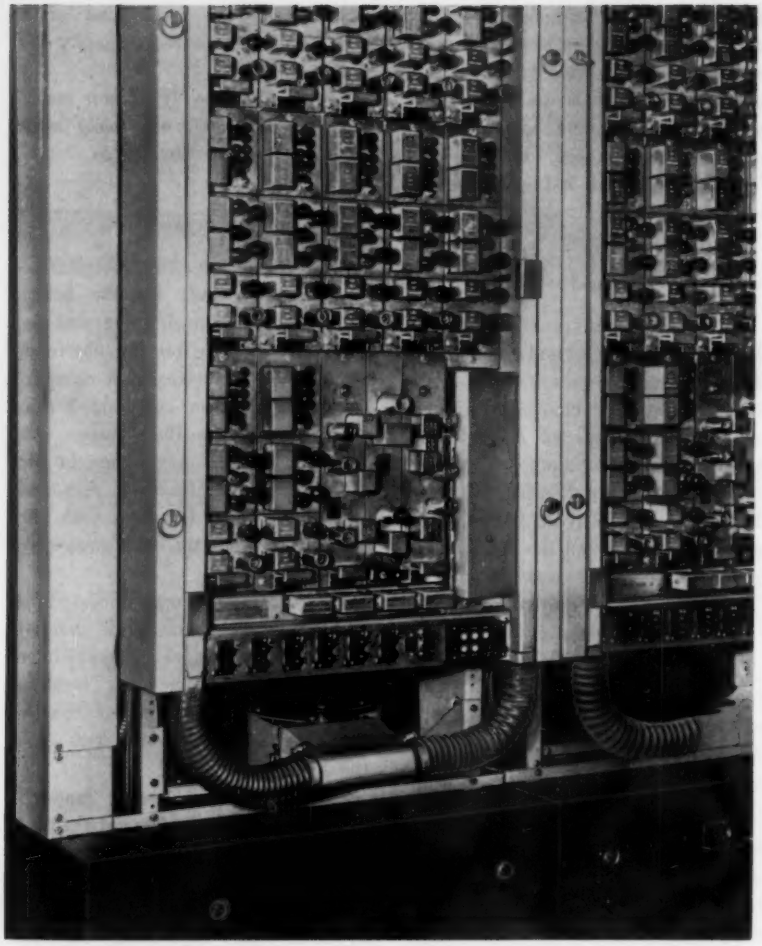
UNLESS FOUNDATIONS are properly designed, the "jet" action of gas line blowdown valves can seriously damage a piping system, according to engineers of the Rockwell Manufacturing Co.'s meter and valve division.

Action of the blowdown system may be compared to a jet plane's engine. When the valve is opened, the gas issues into the atmosphere at the velocity of sound. The high-velocity jet action of the discharging gas results in a reaction in the blowdown system, causing it to move in a direction opposite to that of the gas.

In a recently investigated case the jet effect amounted to the equivalent of 16,000 hp — far greater than the power of any jet plane in existence.

To avoid severe damage to the blowdown system resulting from this phenomenon, it is necessary to design and install a foundation that can take the reactive force. The jet effect is most severe at the beginning of the blowdown period. As the line pressure decreases to zero, so does the jet effect. In designing the foundation, account should be taken of the maximum force exerted by the jet effect, rather than taking an average figure for the force during the entire blowdown period.

The size of a blowdown branch is usually a fraction of the pipe line diameter and is calculated to meet the desired blowdown time. The latter may vary anywhere from one-half an hour to as long as one-half a day. And the shorter the blowdown, the greater the jet action. In general, gas pipe lines are divided into 10-mile sections with a blowdown valve at the end of each section. The foundation support for each of these valves should be designed to absorb the reaction force of the jetting gas.



1 A SMALL BLOWER and rectangular ducts at the sides of each relay bay are provided for removing the heat generated

New Ways To Cool Telephone Terminals

By J. A. Coy, Engineer

Carrier Systems Development
Bell Telephone Laboratories

• "Miniaturization" of communications equipment in order to conserve space, lighten weight and reduce cost poses a problem in how to get rid of the heat generated without impairing equipment operation. Use of blowers, combined with careful arrangement of component parts, goes a long way toward effective heat removal. Air conditioning, with apparatus components located so as to take full advantage of it, is economically feasible in some cases.

LARGE QUANTITIES of heat are liberated in the present day compact telephone equipment sometimes installed in small rooms. The recent trend in miniaturization of apparatus, the liberal use of electron tubes, the concentration of equipment into cubic units rather than on flat panels, and more circuits to meet demands for toll service increase the amount of heat to be dissipated in a single office. Installations of 120 or more carrier terminals in one central office, which will soon be commonplace, will release 42 kw of energy, or more than 140,000 Btu per hr, into a room 20 by 30 ft.

Nearly all of the heat generated in a carrier terminal originates in the electron tubes. For this reason, the tubes are mounted on the fronts of the units where the maximum amount of heat may be carried away by conduction and radiation. By this arrangement, the minimum amount of heat reaches the body of the unit. Within this body are mounted the elements that do not produce any appreciable heat — including the thermistors and varistors — and whose operation is most affected by abnormal temperatures.

Small Blowers Used

To remove the heat from the units, a small blower is mounted just below the bottom terminal in each bay of equipment, as shown in Fig. 1. Air from this blower is delivered through two rectangular ducts up the sides and then is discharged in jets just below the areas where the electron tubes are concentrated. One of the jet discharge openings may be seen in Fig. 1 on the duct on the right near the clamp. Air jet velocities of 2700 to 4100 fpm are sufficient to distribute the air well across the bay.

The blower delivers about 100 cfm of air to the entire bay with 5 to 8 cfm through each of the 15 jets — nine on the left and six on the right. The temperature rise in the bays is thereby reduced to half the amount that would occur with only natural cooling. With this arrangement, good operation of the equipment may be expected with an ambient

Mr. Coy has been associated with the Bell Laboratories for almost 40 years and for about 25 years he has been concerned with equipment development. Mr. Coy's article is reproduced through the courtesy of the Bell Laboratories Record.

temperature up to 105 F as measured in the center of the aisle in front of the carrier terminals. Permanent injury to the equipment is unlikely even if the room air temperature should rise as high as 130 F with the blowers operating, or to 100 F with the blowers stopped. This is true even in a large installation with bays back-to-back in each line and facing each other across the aisle.

Heat Generation per Cu Ft

On the left side of Fig. 2, the heat generated in carrier terminals and in various other types of equipment is compared on the basis of watts per cu ft of room volume. Room volumes per bay, shown at the top of the chart, have been assumed for various types of bay arrangements. They include allowances for lockers, a bench or a desk for attendants and aisle spacings. It will be noticed that the more recent developments, such as the type N and type O carriers, E-2 repeaters, the telegraph service board, and 2600 cycle ringers are all heavy producers of heat while the older types of equipment produce relatively small amounts per unit space.

Three Methods of Heat Removal

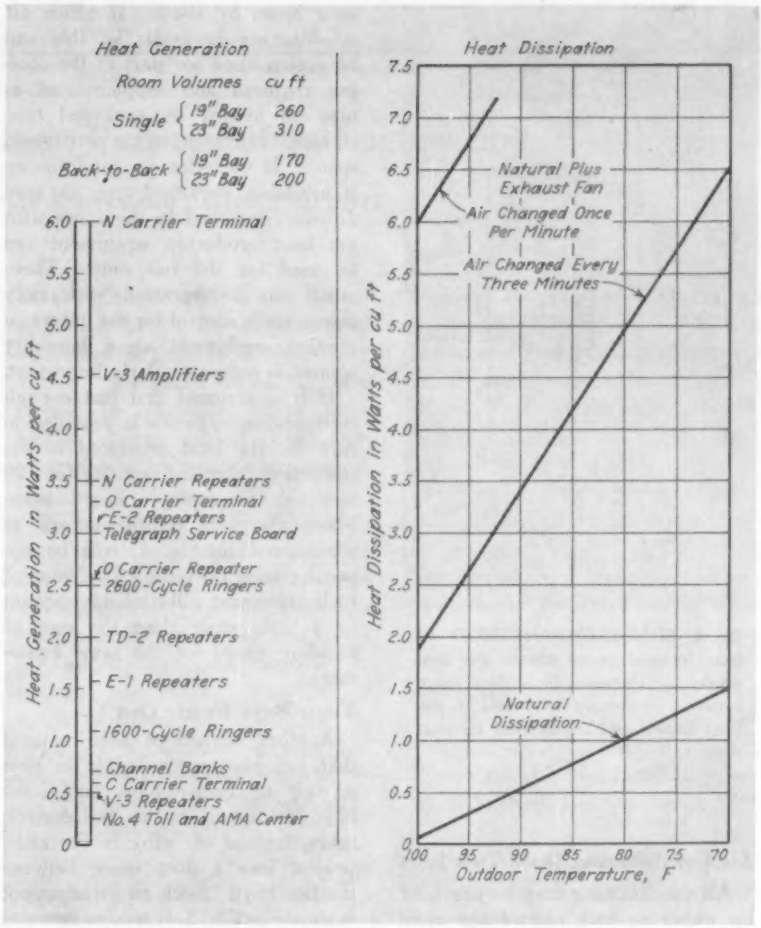
The heat generated in the equipment must eventually be removed from the building. The three ways of accomplishing this are by natural dissipation, circulation of outdoor air through the room by means of an exhaust fan and by air conditioning.

Obviously, natural heat dissipation becomes progressively ineffective as the outdoor temperature approaches the maximum temperature to be allowed within the office — particularly with the windows closed. As indicated by the right side of Fig. 2, it cannot under these circumstances, be depended upon to any considerable extent in summer.

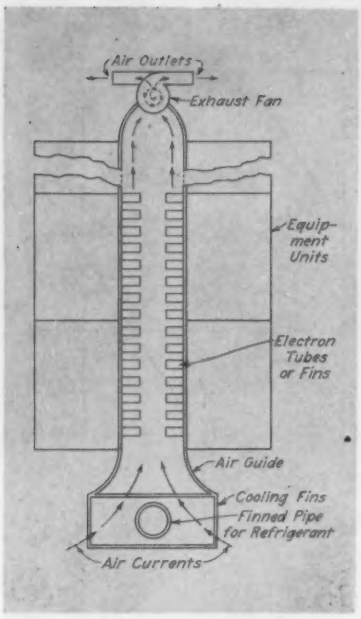
Exhaust Fan Effective

Very effective heat removal can be accomplished by using an exhaust fan to take the heated air out of the room and by providing grilles for make-up air. A rather conservative assumption of an air flow rate that will completely replace the air in the room every three minutes, will give a heat dissipation varying from 2 watts per cu ft with an outdoor temperature of 100 F to 6.5 watts with an outdoor temperature of 70 F. as shown in Fig. 2. A recent experiment in one of the offices indicated that an air flow rate as high as one air change per minute can be tolerated. This — also indicated on Fig. 2 — will provide a heat dissipation of 6 watts per cu ft even at an outdoor temperature of 100 F. These dissipations, of course, are based on the assumed office temperatures of 100 F at the floor and 115 F at the ceiling. These correspond to the 105 F temperature that has been established as tolerable for N-1 carrier terminals with blowers. Careful engineering is required to introduce and distribute the air at such high rates to permit the equipment to be cooled with the least disturbance to personnel. In the example mentioned, an air change of one per minute is not unpleasant on a hot day. However, as the outdoor temperature falls the air flow rate can be reduced in proportion to the difference between the outdoor temperature and the maximum allowed in the room, so as to avoid too objectionable velocities of the cool air.

Air changes as rapid as one per minute for a room of any size are relatively inexpensive if outdoor air can be admitted directly from and exhausted directly to the outside of the building. To deliver and return the air through ducts of a considerable length may make this method prohibitive because of the cost of the ductwork. Under these circumstances, the provision for air conditioning becomes necessary. This type of air conditioning is not, however, considered so formidable as it was even a few years ago.



2 HEAT GENERATION and heat dissipation characteristics are shown here for type N terminal offices



3 A SUGGESTED METHOD of heat removal is to mount the heat producing elements in a duct space between equipment bays and to deliver cooled and conditioned air over them

Air Conditioning Does Two Jobs

Air conditioning may be provided for either or both of two purposes. The first of these is for the comfort of personnel in operating rooms or operators' quarters, and the second is for the improvement of equipment operation — primarily in switching and terminal rooms. Both temperature and humidity control are ordinarily provided in these installations. Where both of these purposes are fulfilled, the air is filtered, cooled and dehumidified to the required degree in a central unit. The conditioned air is circulated through the spaces and is then returned to the cooling unit where a small amount of outdoor air for ventilation is introduced.

Installations of this dual purpose type are generally engineered to provide a uniform distribution of air over the entire space to be conditioned. The balance is seriously upset when a large concentration of heat is introduced into a small part of the space. Consequently, it is generally preferable to separate high heat producing equipment from the remainder of the office or locate it in a room by itself. If office air conditioning is available, this can be drawn upon for part of the cooling required and supplemented as may be needed by packaged type air conditioners within the partitioned space. If no office air conditioning is available, packaged type air conditioners installed in the room with the heat producing equipment can be used for the full duty. These units can be operated with only thermostatic control for the toll transmission equipment since humidity control is not particularly important.

If it is assumed that just enough refrigerating capacity is provided to care for the heat generated in the equipment, then the capacity for 120 terminals, for example, in a location where the heat conditions are as represented in Fig. 2, will be approximately 12 tons. The cost of such equipment will probably amount to a little more than the cost of building space for the same equipment.

Turn Bays Inside Out

Another method of heat removal that has been suggested is to turn a pair of back-to-back equipment bays inside out, so that the electron tubes, instead of being in the aisle, project into a duct space between the two bays. Such an arrangement is shown in Fig. 3. It is here assumed that the equipment units are mounted on two sets of bay uprights with the heat producing elements in the space formed by placing the two bays together. This space is completely enclosed, and air is introduced at the bottom and exhausted at the top.

There is a finned pipe through which the refrigerant is circulated at the base of the bays. This pipe should have a temperature above freezing so that frost will not form. Of course there will be condensation of moisture from the air so that a drip pan and drain are needed. It does not appear necessary to dry the air since the equipment is so much warmer than the saturated air that it will not be damaged by it. A fan exhausts the air at the top from the enclosed space. Inlet openings at the bottom of the bays admit room air to flow over the cooling unit. In order to conserve refrigeration capacity, it may be desirable to recirculate the exhaust air back into the base of the bay.

The practicability of such an arrangement may be investigated by looking at the type N-1 carrier terminal bays. In a pair of these bays 2100 watts or 7200 Btu per hr will be generated. If it is assumed that the temperature of the cold pipe is 42 F and the air exhausted at the top of the bay is 90 F, a temperature difference of 48 F will exist. By using a simple exhaust fan, for example, a duplex unit with two 3 in. blower wheels, driven by a $\frac{1}{8}$ hp motor, an air flow rate of 200 cfm can be obtained. Calculations indicate that this rate of air flow over the cooling unit and past the equipment area will give about the air temperature differentials assumed, and that the maximum temperature rise in any piece of apparatus will be maintained at a satisfactory limit.

An alternative to circulating refrigerant through the base of the bays would be to bring in cool air at the end of a line of bays. This appears practicable at least for moderate heat dissipations. A cool air duct would distribute the air from a central unit through the base of the bays, and a return duct would bring the heated air back from the top of the bays.

The amount of refrigeration capacity required by either of these methods would be about the same as that previously described for conventional equipment arrangements, provided it is assumed that the refrigeration simply removes the amount of heat generated in the equipment. Neither method should be objectionable from the standpoint of the comfort of the personnel.

Various other methods of arranging equipment have been suggested, but these seem typical of any that would adequately remove large quantities of heat. Although the arrangement of inside-out bays appears practicable, it is realized that there are formidable difficulties in the development of not only radically new equipment unit designs but also of new frameworks, methods of cabling, office layouts and other factors that will become apparent as any development along these lines proceeds. In this preliminary view, the inside out arrangement shows no great advantage over a conventional arrangement with the equipment segregated in a room that can be air conditioned.

ON THE JOB

Snow Melting Part of Safety Engineering

. . . at new Worcester, Mass., airport

HEAT TRANSFER OIL is circulated through the network of piping to warm the concrete pavement

SAFETY ENGINEERING is not limited to landing strips and flight control equipment at the new $500,000 city airport, Worcester, Mass. It also extends to sidewalks, where snow melting systems protect airline passengers, workers and visitors against falls due to ice and snow.

Three separate sidewalks serving the airport's administration building and control tower are now equipped with snow melting systems. Sidewalks are heated by circulating heat transfer oil through the network of wrought iron piping, according to the A. M. Byers Co.

Two of the sidewalk heating systems are installed between the building entrance of the administration building and the street. One serves a sidewalk 12 ft wide and 24 ft long, the other a walk 10 ft by 220 ft. The third system is embedded in an area that leads from the administration building to an aircraft parking area.

Snow melting systems also serve two plane hangars in which pipe coils are embedded below the tracks of large sliding doors — 150 ft long and 5 ft wide. In these installations, snow melting prevents the big doors from becoming clogged with snow and ice to facilitate plane maintenance operations in cold weather.

The snow melting systems were designed by Hayden, Harding & Buchanan and the installation was made by J. G. Lamotte Co.

Tubeaxial Fan Ventilates Country Club Kitchen

. . . remodeling increases load

IMPROVED VENTILATION and better working conditions got major attention during remodeling of the kitchen of the Miami Valley Country Club, Dayton, Ohio, according to the Ilg Electric Ventilating Co. New ranges were installed which necessitated a new and larger canopy.

Dimensions of the new canopy are 24 ft × 4 ft, giving a total canopy covering area of 96 ft, which is twice as great as provided by the previous canopy.

The duct-mounted fan, mounted on the roof in the duct near the end, is equipped with a self cooled, 2 hp motor with double sealed permanently lubricated ball bearings. Capacity of the fan at zero static pressure is 10,400 cfm of air at 1140 rpm.

TUBEAXIAL FAN INSTALLATION is shown in this roof view

DUCT FOR FAN is behind canopy over range in kitchen

The fan wheel and motor are direct connected and are mounted in a heavy welded steel housing. Flanged ends permit easy installation. The fan is horizontally installed but could be installed in any other position.

PRACTICAL PIPING PROBLEMS

By Bill Dopp

What It Takes To Close a Valve

"When a valve's closed right, it's tight," says Martin MacVane, the Sherlock Holmes of piping problems. In this case — a new boiler installation — a hammer-blow handwheel, deliberately removed from a heavy valve to make the valve easier to install, was not put back on. Discovering the missing handwheel and the improperly closed valve, Mac demonstrates why the boiler test pressure went up to only 800 psi, instead of 2300 psi.

As Mac stepped into the boiler room of the Durant city power station, he met the usual mess from the erection of a new boiler. He scanned the scene for Phil Brooks, the chief engineer, an old friend. Near the boiler he saw a huddle, with Phil at the center.

Mac wandered about, sizing up the new installation. Phil spotted him. "Come on over, Mac!" he called. "Maybe you can solve this puzzle."

Mac was reluctant to butt into the discussion, but his friend waved him into the circle. "Fellows, this is Martin MacVane, an old-time engineer. Perhaps he can make a suggestion." Phil introduced the others — Jim West, boiler erection superintendent — Ed Morris, piping supervisor — and Dick Thompson, his assistant. Each nodded, Jim West showing some impatience at the interruption.

Can't Get Pressure Above 800

"Jim's got a problem, Mac. None of us can figure what's the trouble." He put his hand on Mac's shoulder. "Let's see if you can."

Mac turned silently toward Jim, waiting for the boiler man to tell his story. Jim hesitated a moment, then exploded. "We're trying to make a hydrostatic test of this boiler," he blustered. "The inspector will be here any minute, and we can't get the pressure up above 800 lb, let alone 2300! We've tried everything. I'm stumped." He glared at the group, as if they were to blame.

Mac was silent for a moment longer, then asked, "Any air in the system?"

"No!" declared Jim emphatically. "We've gone over every part of the installation a dozen times. The pump builds the pressure up to around 800 rapidly, then sticks there. If air was present, it would take a lot longer." He motioned to the assistant engineer to start the pump. All eyes were on the test gage. The needle climbed steadily to 850, then slowed down and stopped. They waited. The pump kept going but the gage stayed almost fixed.

"Check the gage?" asked Mac.

"Yep, tried two of them," barked Jim.

Mac gestured to the man at the pump, who responded by closing the outlet valve. The pump stopped, while the eager group watched the gage. Slowly, it began to recede. Down went the needle steadily, until it stopped at just below 800. Jim eyed Mac shrewdly.

"Look like air to you?" he demanded.

"No," admitted Mac guardedly. "It's either a leak in the boiler or in a valve."

"I told you we've gone over everything a dozen times!" erupted Jim irritably.

"You want to find the trouble, don't you?" asked Mac patiently. "What do you think, Phil?"

"I think you'll have to go over everything again, Jim. There's an answer to this somewhere."

Mac had a bright idea. "Safety valves tight?" he asked hopefully.

"Not on," retorted Jim. "All blanked off, and the joints are tight." He groaned. "We'll start over. Leave the pressure on while we check the valves." He moved away disgustedly.

Water Glass Drain Valves Leak

Phil led Mac over to the other boiler. "Jim loses his temper and stops thinking. There's a leak somewhere. Sometimes it's hard to find what causes them. I've got a couple that get my goat."

"Serious?" asked Mac.

"Not exactly, but annoying," replied Phil. "It's the water glass drain valves on this boiler. The valves appear to be closed tight, but after awhile they begin to seep. If you don't follow them up periodically, they begin to cut and before you know it

Bill Dopp has had some 40 years of experience dealing with piping, including a long stretch as a sales engineer. He is devoting part of his present leisure to writing of his many piping experiences. All the names used are fictitious.

you have to replace them."

"Pressure under the disc?" asked Mac casually.

"Sure. They're water valves. According to the rules, that's where it belongs."

"What rules?" inquired Mac innocently.

"Why. . ." Phil hesitated. "Anyway, it's general practice," he declared evasively.

"I don't know of a thing in either the boiler or the piping code that says you have to install a water globe valve with the pressure under the disc," contended Mac. "Turn those valves around and that trouble will be over," he asserted confidently.

"I know all the arguments for keeping the pressure on top of the disc in steam valves, but the stems of these valves can't possibly have contracted since they were closed. Then, too, if we turn these valves around, the load will be on the packing all the time," said Phil.

"Think a minute, Phil," urged Mac. "You've got almost 1600 psi on the bottom of that disc. If the stem shrinks a couple of thousandths of an inch, you've got a leaker." He touched the handwheel. "That's pretty hot, but certainly not up to the 600 degrees that you've got in that water."

Mac paused thoughtfully. "Phil, this is the old story of unequal expansion in a small valve. Nobody knows exactly what takes place when you open that valve for a few minutes and then close it on a hot line. You'll agree, I'm sure, that with 1600 psi on the top of that disc any slack, no matter what causes it, will be taken up."

"Of course," affirmed Phil, "but what about the packing?" His satisfied grin made Mac smile.

"What about it?" chided Mac. "That packing was made to hold the pressure inside the line. Suppose the valve was in the open position all of the time. You would not backseat it to protect the packing, would you?"

"No," confessed Phil slowly. "But it doesn't do it any good." He could see the argument slipping away from him.

"And it doesn't do it any harm," declared Mac, positively. "Modern packing, when properly applied and followed up, doesn't have to be nursed like that." He was about to go on when they were interrupted by the approach of a short, stocky, belligerent individual.

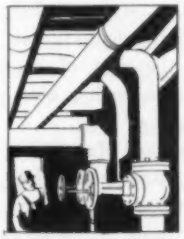
"They're Drowning Us Out"

"Where's Ed Morris," he demanded. "They're drowning us out down there."

"Down where?" asked Phil.

"We're working on the steam header. Water is pouring into it from somewhere. Everything is being flooded. Where's Ed?"

"Up on the boiler, somewhere," replied Phil. "We'll try to find him."



They went back to the new boiler just as Ed and Jim emerged from the other side. Jim appeared in a fighting mood. "Brooks, it's that stop-check valve that's leaking. Ed says he's done everything he can to get it tight. We're going to have to take the pressure off the boiler until they can get it fixed. That boiler inspector will be redheaded if he gets here and we are not ready for him."

"It's the stop-check valve, all right," contended Ed. "We can't get it tight. We'll have to give up the test until we can take it apart and see what's the matter."

"Can we get a look at it?" asked Mac.

"I suppose you're going to look right into the valve and tell us all about it?" demanded Jim.

"Don't pay any attention to him," pleaded Phil as they made their way to the elevator and the top floor. There was a small stair up to a little catwalk on top of the boiler alongside the valve. Workmen putting covering on the boiler lead moved aside as the group came up. Mac, however, remained on the floor. One glance at the valve had been quite enough for him. He walked away, apparently looking for something.

"What's that guy looking for?" demanded Jim of Phil. "Does he think he will find the answer away over there?"

"He might, at that," replied Phil, evidently enjoying Jim's agitation.

"Did you find it?" demanded Jim.

"Yes," Mac replied.

"How Did You Close Valve?"

Everyone eyed him expectantly. Keeping a poker face, Mac turned to Ed. "How did you close that valve?" he asked.

"Why, with a wrench, of course."

"Is that the wrench over there?" Mac pointed to a 24 in. wrench on top of the boiler.

"Sure," retorted Ed defensively. "We used that 5 ft pipe, too."

Mac studied the offending valve thoughtfully. "Phil," he said, "that 10 in. valve has a disc area of about 78 sq in., hasn't it?"

"Yes, about that," answered the engineer, a twinkle in his eye.

"At 2300 lb, that's a load of. . ." —Mac stopped to think a moment— "say roughly 180,000 lb. Even at 800 it would be over 62,000. Some man!" he laughed, tapping Ed on the shoulder. "Closing that valve with a wrench." Ed joined in the big laugh.

"You ought to know better than that," Mac declared sharply, turning to Jim. "What in thunder do you think the manufacturer put a heavy hammer-blow handwheel on that valve for?" He pointed to the wall. "To have it lying over there?"

Both Ed and Jim were red faced. Phil enjoyed their discomfiture. Mac quietly but firmly took command. "Get a couple of your men to bring that handwheel over here." Ed waved to a man standing near. "One won't do," declared Mac. "That thing's heavy. Better get a dolly," he said, as the man started for the part. "Why did you ever take that wheel off the valve?" he asked Ed.

"The valve was so clumsy to handle with the wheel on. It's so big and as you say, heavy, that we took it off to make it easier to install the valve. I suppose I look like a sap to you, but I don't see why the wheel is so important."

Install Hammer-Blow Handwheel

Getting the big wheel onto the valve took the efforts of two husky men. The washer and nut were finally firmly in place. Mac stood gently swinging the wheel back and forth, with a thoughtful expression. "Wonder if all the air is out of the boiler?" he mused. Turning to Phil, he suggested, "Perhaps we better crack this valve for a moment. What's become of Jim?" Everyone looked around, but the boiler man was gone. "Will you send someone down and ask our friend to put a little pressure on this kettle?" he asked Ed.

"Okay," the supervisor responded cheerfully. "Maybe now we'll get somewhere." They waited a few minutes for the message to get to Jim. Finally Mac said, "All right, Ed, slam that valve shut." There was a real bang as the hammer-blow struck. "Again," he commanded. "That's it. Now, once more." Ed looked inquiringly at the visiting engineer, who grinned back at him. "Afraid you'll break it?" he asked jokingly. "It's tight. Now let's see that valve leak." He started down the little stairway. "I want to see this. Let's go down to the boiler room floor." He was chuckling to himself.

As they descended in the crowded elevator, Ed Morris asked Mac, "Why do they have to put such a heavy and powerful handwheel on that valve? That thing strikes a terrific blow!" He shrugged, "I should think that it would ruin the valve."

"That valve is built to take that kind of a blow," declared Mac. "The seating surfaces are as hard as flint and the resulting blow on the seat is not as great as you might think." He paused as they left the elevator. "You've got a line seating in that stop-check. In a 10 in. valve the blow is spread over a line more than 30 in. long. You're really not applying as much force as you think."

Jim was standing beside Dick Thompson at the pump. The gage already stood at 1200 and was mounting steadily. When it got to 1500, Jim raised his hand and Dick stopped the pump. The group maintained an expectant silence, watching the gage. When after a few minutes the needle remained fixed, Jim nodded and Dick started the pump again. There was instant response on the gage. It took only a few strokes to bring the needle to 2300 lb.

The group was stiff with tension. Everyone waited for someone else to speak. Jim said, "You were right, Mr. Mac. The valve's okay. I sure made a fool of myself."

"Don't let it worry you, old man," urged Mac. "We all make mistakes."

"Why Doesn't Blow Tear Seat?"

Glancing at the steady gage needle, they turned away. Ed followed Phil and Mac to the door of the turbine room. Diffidently, Ed said to Mac, "Mr. MacVane, I'm still puzzled about that valve. Why doesn't that hammer-blow tear the seat of the valve. In a small valve, such a blow would wreck the valve."

"Sure it would," agreed Mac. "You must remember, in a stop-check valve the stem is not attached to the disc. Once the disc has come in contact with the seat, it remains in that same relationship. If the disc could swivel, as it does in many small valves, your thought would be perfectly correct. The seat would be ruined by any excessive blow." They stopped near the door. Phil nodded in agreement.

"You see, Ed," explained the engineer, "this is not a typical angle valve. It's really nothing but a lift check valve. The only purpose of the stem is to lock that disc in place when the check closes, just as you did a few moments ago. When you run the stem up to the open position, the disc will remain seated until the steam pressure in the boiler gets higher than the pressure in the line."

"It's funny how a person forgets some of these things. If I'd thought for a minute, I'd never tried to close that valve with a wrench."

"You and Jim have had quite a day," laughed Mac. "Better luck next time." He turned to follow Phil.

"This has been quite a lesson to those boys," remarked Phil.

"We usually get them when they're due," laughed Mac. "Don't forget what I told you about those drain valves."

Closing Wedge Gate Valves

"I won't," Phil replied. "But this hammer-blow handwheel has set me thinking. I've got a couple of good sized gate valves that are really hard to close. Why can't I put hammer-blow handwheels on them? The last few turns when you're closing those valves is some job. It takes two huskies to manage it."

"Wedge gates, I suppose?"

"Yes. Steel bodies."

"Well, you can put hammer-blow wheels on them all right, but unless you can guarantee that no one will ever abuse them, I'd hesitate to do it."

"Why?"

"Well, let's look at what happens when you close one of those valves. As it comes to its seat, the disc slides over the seat ring. Under only relatively light loads, if the metals are similar, this slight sliding will cause the metals to gall. Now you propose to hammer the disc down, forcing the metals closer together and also forcing a further sliding action. Even with proper metals, they may seize. Then, too, you may spread the body so much that the disc will become pinched, and even your hammer-blow wheel will have a hard time getting the valve open."

"I see your point," observed Phil. "In the stop-check, there is no sliding action, so that even if the metals knit, there'll be no damage."

"That's just it. You have to have the right metals, of course. They'll knit to some extent. That's what insures the stop-check being tight. In a gate valve, or in a globe with a fixed disc, or in one that will not swivel freely, you will have trouble in no time."

"We won't go looking for trouble," declared Phil.

"If you use those valves with any great frequency, you might give some thought to motor operation," suggested Mac. "This much is a sure thing. If you close a valve right, it'll be tight." He chuckled and turned to go. "So long!"

By William Hurd Hillyer

"Get It In Writing!"

AN ENLARGED contract job does not always fulfill a subcontractor's fond expectations for added profit. Neither does it pay, for the sake of being obliging, to depart from a written agreement. Particularly is this true when one's good nature relies upon an oral agreement to cover the difference in cost for doing the general contractor a favor. A recent case shows why.

Thermatt Heating and Air Conditioning Co. (all names herein are fictitious) was subcontractor under Twynne Bros., general contractors, for the installation of heating, piping and air conditioning equipment at Okedoke city hospital. Thermatt submitted to Twynne Bros. a written bid of $64,000, which was accepted. After construction had begun, the city of Okedoke requested bids on what it called "change order No. 4," covering certain structural extensions. Before making any proposal thereon, Twynne Bros. obtained from Thermatt a written bid of $1235 for the extra heating equipment required. The general contractors accepted this bid and included the sum specifically in their own bid for the entire additional construction.

As work on the original structure progressed, Thermatt was directed by Twynne Bros. to proceed with his share of that project while awaiting action on the bids covering change order No. 4. Thermatt objected, protesting that his bid of $1235 was dependent upon construction of the original and supplemental items at the same time. He claimed that to complete the first project and then make the necessary changes would entail much greater expense. Being a "good fellow," Thermatt was "prevailed upon" to finish the original job on the promise of Twynne Bros. employees that their firm would pay the additional expense.

After all of Thermatt's work was done, both original and extended, Twynne Bros. mailed him a final check for $12,413 to complete the agreed sum of $64,000 plus $1235 — with an itemized statement showing the enclosed amount as balance in full due him after crediting the general contractors with previous payments.

Surprised and annoyed, the subcontractor wrote Twynne Bros. to this effect: "We received your check and statement, but the $1235 shown as compensation for change order No. 4 is not correct. You will recall that the additional changes ordered by you after the plan was revised were made by us with the understanding that you would pay for such changes. Therefore we are accepting the check you sent us, but not in full settlement of the correct amount. We shall get in touch with you shortly to discuss 'the true balance due us'."

Thermatt cashed the $12,413 check, but when Twynne Bros. refused to settle his claim of $2274 — additional cost incurred by doing the work in a series instead of simultaneously — he sued for that sum as balance due and unpaid.

The general contractors answered in court that the work required by change order No. 4 was a separate contract, whereon the subcontractor had submitted a written bid which had been accepted. Hence, he had been paid in full for all the work required of him.

Thermatt's evidence established his facts, but Twynne Bros. filed a demurrer — legalese for "even if true, we don't owe it." When the court sustained the demurrer and threw out Thermatt's case, he appealed to the state supreme court.

But he fared no better. Said the justices: "A person who agrees to do for a fixed sum a thing possible to be performed will not be excused or become entitled to additional compensation because unforeseen difficulties are encountered." The supreme court held that the subcontractor, having submitted a written bid to the general contractors for work on the change order and the bid having been accepted, he was bound to do the work for the agreed price.

The fact that one or more of Twynne's employees induced Thermatt to perform the work in a manner or at a time which caused additional expense did not change the situation. Furthermore, the higher court saw merit in the general contractors' contention that by accepting and cashing the check offered in final payment, the subcontractor had acknowledged payment in full. This point, however, the court left undetermined in affirming judgment against Thermatt and in favor of Twynne Bros.

If Thermatt had been less good natured, less unthinkingly trustful, he would have been unimpressed by oral assurances of the general contractors' employees and would have required an agreement signed by Twynne Bros. themselves before proceeding with the work in the order they desired. Such precaution might have made him richer by some $2200 and saved him court costs and attorneys' fees.

[Note: While this discussion applies to an actual case, it should be remembered that legal rules vary in different states.]

How Ventilate Cafeteria Kitchen?

• *IF YOU DON'T HAVE the answer to a heating, piping or air conditioning problem, chances are some else does — or can be helpful on part of it. That's the reason for HPAC's Question of the Month "idea exchange."*

THE QUESTION, *How To Ventilate Large Cafeteria Kitchen?*, was published previously in HPAC and is repeated here for information. Some answers were published in January. Here are some others that have been received. Other comments for publication will also be welcome.

"An extensive and complete ventilating system was installed when a modern cafeteria was built three years ago, but the 41 burners in the kitchen, when operating, proved to be too much for the system. The temperature in the kitchen is unbearable for the four cooks, bakery personnel and other occupants. What is the best approach in revising an existing ventilating system in a cafeteria kitchen so that it will perform satisfactorily? I would like to use refrigerated spot cooling to help solve this problem, but it would take many tons of refrigeration capacity to remove the burner heat alone. There must be some more practical method than this. I would appreciate seeing how other HPAC readers have attacked similar problems."

MILTON DORMONT —

"Spot Cooling By Outside Air Is Effective"

IN EVALUATING the problem, the cafeteria operator would be wise to seek the answers to the questions posed by J. Belunas in the January HPAC. Often the operator of systems involving mechanical equipment fails to realize his responsiblity in cooperating with the engineer to establish the true requirements to be fulfilled and often fails to maintain the system properly after it is installed. Unfortunately, there are also cases of substandard design.

Since the cafeteria is relatively new, it may be assumed that it is air conditioned. One method for obtaining cooling effect is available where the kitchen and cafeteria are properly located relative to each other. The cool air in the cafeteria is drawn across the kitchen and exhausted through the range and oven hoods. This can be done by the use of judiciously placed transfer grilles in the partition separating the kitchen and cafeteria, with fire dampers provided where required by code.

Usually, greater air movement and greater air volumes than are furnished in this way are necessary to satisfy the demands of the cooks and the hoods, respectively. I believe the soothing action of the passage of air over the perspiring brow of a chef, as he stands in front of a radiator in the form of a range, is more effective than an attempt to maintain a low temperature throughout the entire kitchen. Therefore, supplementary outside air for spot cooling is introduced to the kitchen at strategic stations. This latter air may be refrigeration cooled or may be at outside conditions, tempered for winter use. The choice will depend on the economics of the situation.—MILTON DORMONT, Mechanical Engineer.

EDWARD F. WEHLAGE —

"Air Quantity May Be Inadequate for Comfort"

DISCOMFORT for kitchen personnel resulting from radiant heat from equipment is difficult to overcome. But maintaining a reasonable balance between air supply and exhaust, and judicious application of cooling in hot climates, will virtually eliminate the extremely unpleasant conditions associated in the past with large kitchen operations.

I assume that the "extensive and complete ventilating system" which was installed is designed and operates according to modern practice. Without question, this should remove the products of combustion and vapors from the food being prepared. But the air quantity may be inadequate to provide comfort cooling by ventilation or air movement.

It is apparent that little attention was given to the supply of outdoor air when the system described in the question was designed. The problem of make-up air has been neglected so seriously that some of our larger cities are now requiring the installation of air supply units to offset the exhaust requirements. To supply outdoor air to a kitchen under normal conditions for a large restaurant operation means virtually 100 percent make-up air.

Where cooling of personnel is required, the minimum requirements for exhaust may be inadequate to provide enough air movement to produce a sensation of comfort. Some idea of these air volumes can be secured from papers which have been presented at various ASHAE meetings. The data developed by some of our large industrial corporations on the extent to which ventilation will produce comfort cooling can very well be applied for restaurant kitchen cooling.

In the writer's practice, it has been found necessary to apply refrigeration in southern cities to produce a satisfactory level of cooling for good employee working conditions. One large kitchen, similar to that described in the question, was comfortably cooled with 40 tons of refrigeration, using 100 percent outdoor air. Considering the production of the help and the hours operated, the expense was not excessive.

In many localities, it is possible to draw dining room air into the

READER ASKS —

"What Causes Book Pages to Crinkle?"

"A bookstore in Montana with a 250,000 volume stock of used books suffers considerable loss from warping and crinkling of the paper pages. It is not practical, however, to install air conditioning, or even to provide a well insulated, heated building since the books are mostly low priced. The damage occurs during severe cold spells.

"The local annual rainfall is 15 in., and the water table is below 33 ft. The building, on a well drained site, is partly floored with concrete. Part has dirt floor topped with gravel, then concrete blocks. Over the blocks is a platform on which book stacks stand. Part of the building has a double ceiling and part has side walls which are provided with double sheathing and two layers of tarred felt and an exterior of aluminum sheet metal.

"The trouble does not seem to be capillary moisture migration, or excess humidity in the atmosphere. Excess humidity never damaged the owner's books in over 20 years in California, nor did 120 F heat.

"Books moved to the heated office during cold spells quickly warp unless humidity is kept up, but in distant unheated parts of the building, cold alone seems to warp and buckle the paper. Is this caused by the small amounts of moisture traveling in and out of paper? Extreme cold has the same effect as extreme heat; both cause rapid dehydration and consequent wrinkling. On the other hand, vapor pressure decreases with the temperature. But does not vapor pressure cause moisture migration? Yet books placed in the owner's deep freeze don't seem to buckle at zero F.

"The owner's experience indicates that reasonable moisture does not hurt his books, but something here does. Is it the lack of moisture and/or moisture movement due to temperature extremes? Ventilation or the lack of it does not seem to help.

"Will cold alone do real damage, or are there unrecognized factors present? Any comment or suggestion will be greatly appreciated."—D.L.

[You are invited to comment on this question, giving actual examples if possible. Address the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.]

kitchen. The make-up air is then supplied through the main air conditioning unit. (Few dining rooms in warm climates are not air conditioned today.) An adequate exhaust system with fans operating at capacity and rated for sufficient static pressure, backed up by a good air conditioning system supplying outdoor air, will greatly alleviate the objectionable condition in the kitchen.

On some jobs, it has been practical to use 3 to 15 ton self-contained air conditioning units, draw the air from the dining room through the coils, and then distribute it through the kitchen, where it is exhausted. This has been very economical and very satisfactory.

The proper ventilation and cooling of a kitchen is a great boon to the morale of the employees. Wherever it has been applied satisfactorily, it has been well worthwhile. Most failures in restaurant ventilation stem from inadequate design of the exhaust system and failure to provide adequate outdoor air supply or conditioning capacity to back up the exhaust system.—EDWARD F. WEHLAGE, Mechanical Engineer.

• *YOU ARE INVITED to contribute a question for publication, or an answer to a published question. Please address your reply to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

Air Conditioned Inn Replaces Old Structure

. . . at Oberlin

AN "IMAGINATIVELY conceived" new Oberlin [Ohio] Inn incorporating a number of novel features in hotel design replaces the quaint structure in use since 1867 on a hotel site in use since 1834, Oberlin College President William E. Stevenson has announced. The inn combines "motel" type accommodations for motorists with traditional hotel bedrooms and complete hotel and dining facilities. Automobile travelers may park their cars immediately outside those bedrooms on the first floor of the building and have access to the lobby, dining rooms, meeting rooms and shops, via covered outdoor walks along the sides of the building or an interior corridor.

All of the inn's rooms are air conditioned, including the 48 bedrooms on two stories. Overhangs above the windows on both floors provide protection against direct summer sun, but permit sunlight to enter the rooms during the winter months.

The T. O. Murphy Co., Oberlin, is the heating and ventilating contractor. Eldredge Snyder, New York City, is the architect. The general contractor is the Knowlton Construction Co.

SAM LEWIS' PAGE

Of Windows and Wind

THIS PAGE always is circumscribed or, as Caesar would have said, is fenced around so that sharp words by me shall offend others as little as possible. Anyone who reads this in print, therefore must know that it has been scrutinized. Doubtless the remarks printed by Horace Greeley and Joseph Medill similarly were filtered.

Filters are good things. I like the kind that are not sieves but that, like snow fences, invite the filtered-out material to lodge in the quiet spaces to leeward of the barriers.

I have had a little pleasurable fun with a manufacturer who makes glass. This animadverts on casement sash as used in the Chicago City Hall. It also stirs me up about double hung sash in a big Chicago hospital.

In my remarks this month, I'll take a chance on reprisals by architects. Many City Hall windows are fitted with enormous single sash, pivoted at top and bottom at the horizontal center. When one of these windows is opened, one-half swings in and the other half swings out. If there are atmospheric and interior conditions to encourage entry of air, the tall, narrow jet of air from the partly open sash blows the papers off desks that are remote from the window, while any filterable objectionable material, such as snow or rain or soot or dust, cares for the nearby employees.

Sunshades are not practicable for a vertically pivoted sash to control the excess light that may enter through the two room-high slots. If the width of the slot is curtailed, the wind pipes and whistles in its sound as with Shakespeare's ancient lean and slippered pantaloon.

After my experiences with City Hall "air conditioning," I went to recuperate at the hospital (perhaps partly as a result of these experiences!). Here the windows slide vertically and each one is fitted with double-hung steel sash. Each sash has three big thick plates of glass. The arrangement was conceived for the benefit of the window washer and for the harassment of the patient. In the choicest patient's room the area of each window is equivalent to about one-quarter of the floor area of the room.

The counterweights are great long castings inside steel boxes and unfortunately are not quite heavy enough, so that when a lower sash is adjusted to admit a streak of air nearly 5 ft long and less than 4 in. high, the sash almost invariably falls shut and abolishes completely the "air conditioning."

It must be understood, of course, that the entire function toward air conditioning in this great hospital is limited to windows.

There is a radiator below every window and there is a handle, always too hot for one's hand, by which the heat may be shut off. Serious attempts to regulate the amount of heat from each radiator by adjusting the amount of opening of this valve have failed dismally. It happens that the entire radiator must be scalding hot from end to end, or it will not even be gently warm. If the wind pressure is against one side of the building during the heating season, and if the window openings are adjusted with magazines or shoes or folded hospital towels employed as props, and if the radiators are warm, and if the outside temperature is low, the windward rooms may be kept comfortable and may have an encouraging odor.

Positively and definitely, however, the leeward rooms at the same hour must serve as the air-out passages from the windward half of the hospital. During this condition, of course, the hospital fuel employed to heat the radiators on the leeward side passes out the windows to warm the air of Cook County.

The prisoner in the leeward rooms breathes what he can get of the stale air rejected by the prisoners in the windward rooms. He comments on the well-remembered hospital odor. There are no transoms above the doors between the rooms and the corridors, doubtless a wise provision toward control of noises.

All of the doors are undercut, so that there is a slot at the floor 36 in. long and 2 in. high. There is no way to close this slot. The prisoner in bed in either the windward room or the leeward room finds part of his body in the lively air current from window to door-slot or from door-slot to window. The observed tendency, as a result, is to keep the doors open on both the windward and the leeward sides.

Of course, I am prejudiced but after a month as a patient-prisoner in this hospital, I am in favor more than ever of mechanical ventilation and thermostatic temperature control for hospitals. I am in favor of more windows, each one less-wide than those in this hospital. I am in favor of hospitals that are designed to help patients recover.

SAMUEL R. LEWIS, consulting mechanical engineer and a member of HPAC's board of consulting and contributing editors, comments informally each month on practical heating, piping and air conditioning problems.

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Acoustical Society of America, 57 E. 55th St., New York 22, N. Y.

Air Conditioning Blower Manufacturers Association, 2300 Payne Ave., Cleveland 14, Ohio

Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D. C.

Air-Conditioning and Refrigeration Wholesalers, 2607 N. High St., Columbus, Ohio

Air Distribution Institute, 2130 Keith Bldg., Cleveland 15, Ohio

Air Filter Institute, 25000 Miles Rd., Cleveland 28, Ohio

Air Pollution Control Association, 4400 Fifth Ave., Mellon Institute Bldg., Pittsburgh 13, Pa.

Aluminum Association, 420 Lexington Ave., New York 17, N. Y.

American Boiler and Pressure Vessel Laws Society, Inc., 95 Liberty St., New York 6, N. Y.

American Foundrymen's Society, Golf & Wolf Rds., Des Plaines, Ill.

American Gas Association, 420 Lexington Ave., New York 17, N. Y.

American Industrial Hygiene Association, 4400 Fifth Ave., Pittsburgh 13, Pa.

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American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

American Institute of Wholesale Plumbing & Heating Supply Associations, Inc., 402 Albee Bldg., Washington, D. C.

American Iron and Steel Institute, 350 Fifth Ave., New York 1, N. Y.

American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

American Society of Heating and Air-Conditioning Engineers, Inc., 62 Worth St., New York 13, N.Y.

American Society of Heating and Air-Conditioning Engineers Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio

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American Society of Refrigerating Engineers, 234 Fifth Ave., New York 1, N. Y.

American Standards Association, 70 E. 45th St., New York, N. Y.

American Welding Society, 33 W. 39th St., New York 18, N. Y.

Anthracite Institute, 237 Old River Rd., Wilkes-Barre, Pa.

Bituminous Coal Institute, Southern Bldg., Washington 5, D. C.

Bituminous Coal Research, Inc., 2609 First National Bank Bldg., Pittsburgh 22, Pa.

Building Research Advisory Board, National Academy of Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D.C.

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Code for Pressure Piping, ASA Sectional Committee B 31, L. W. Benoit, Secretary, 420 Lexington Ave., Room 647, New York 17, N. Y.

Committee on Steel Pipe Research, American Iron and Steel Institute, 350 Fifth Ave., New York 1, N. Y.

Compressed Air & Gas Institute, 1410 Terminal Tower, Cleveland 13, Ohio

Convector Manufacturers Association, 2159 Guardian Bldg., Detroit 26, Mich.

Cooling Tower Institute, 444 Emerson St., Palo Alto, Calif.

Copper and Brass Research Association, 420 Lexington Ave., New York 17, N. Y.

Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y.

Environmental Equipment Institute, 30 Church St., New York 7, N. Y.

Fuel Oil & Water Heater Manufacturer's Association, 123 Georgia Ave., Providence, R. I.

Gas Appliance Manufacturers' Association, 60 E. 42nd St., New York 17, N. Y.

Heat Exchange Institute, 122 E. 42nd St., New York 17, N. Y.

Heating and Cooling Coil Manufacturers Association, 2159 Guardian Bldg., Detroit 26, Mich.

Heating, Piping and Air Conditioning Contractors National Association, Suite 1843, 30 Rockefeller Plaza, New York 20, N. Y.

Humidifier Association, 2300 Payne Ave., Cleveland 14, Ohio

Independent Insulating Contractors National Association, Room 210, Shoreham Bldg., Washington 5, D. C.

Industrial Mineral Fiber Institute, Inc., 441 Lexington Ave., New York 17, N. Y.

Industrial Unit Heater Association, 2157 Guardian Bldg., Detroit 26, Mich.

Institute of Boiler and Radiator Manufacturers, 608 Fifth Ave., Room 408, New York 20, N. Y.

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Instrument Society of America, 1319 Allegheny Ave., Pittsburgh 33, Pa.

Insulation Board Institute, 111 W. Washington St., Chicago 2, Ill.

Magnesia Insulation Manufacturers Association, 1317 F St., N. W., Washington 4, D. C.

Manufacturers' Standardization Society of the Valve & Fittings Industry, 420 Lexington Ave., New York 17, N. Y.

National Association of Building Owners and Managers, 134 S. LaSalle St., Chicago 3, Ill.

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National Association of Power Engineers, 176 W. Adams St., Chicago, Ill.

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National Board of Fire Underwriters, 85 John St., New York 38, N. Y.

National Bureau of Standards, Washington 25, D. C.

National Certified Pipe Welding Bureau, Suite 1843, 30 Rockefeller Plaza, New York 20, N. Y.

National Coal Association, Southern Bldg., 15th and H Sts., N. W., Washington 5, D. C.

National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6, Pa.

National Electrical Manufacturers Association, 155 E. 44th St., New York 17, N. Y.

National Fire Protection Association, 60 Batterymarch St., Boston, Mass.

National Heating Wholesalers Association, 1200 W. 5th Ave., Columbus, Ohio

National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

National Steam Specialty Club, P. O. Box 191, 666 E. Wabash Ave., Decatur, Ill.

National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14, Ohio

Oil-Heat Institute of America, 500 Fifth Ave., New York 36, N. Y.

Pipe Fabrication Institute, Clark Bldg., Pittsburgh 22, Pa.

Power Fan Manufacturers' Association, 2159 Guardian Bldg., Detroit 26, Mich.

Producers Council, 1001-15th St., N. W., Washington, D. C.

Refrigeration and Air Conditioning Contractors National Association, 10660 Carnegie Ave., Cleveland 6, Ohio

Refrigeration Industry Safety Advisory Committee, 1346 Connecticut Ave., N. W., Washington 6, D. C.

Refrigeration Service Engineers Society, 433 N. Waller Ave., Chicago 44, Ill.

Refrigeration Trade Association of America, 3531 14th St., N. W., Washington 10, D. C.

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Society of Automotive Engineers, 29 W. 39th St., New York, N. Y.

Society of the Plastics Industry, 67 W. 44th St., New York 36, N. Y.

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Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1, Ill.

Tubular Exchanger Manufacturers Association, Inc., 53 Park Place, New York, N. Y.

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Weather Data Analysis for Cooling System Design

Illustrated by Data for New Orleans

By G. V. Parmelee*, Cleveland, Ohio, G. E. Sullivan**, New Orleans, La., and A. N. Cerny***, Cleveland, Ohio

This paper is the result of research sponsored by the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, INC., in cooperation with Tulane University, New Orleans, La.

SUMMARY — Calculation of cooling loads requires careful selection of design weather conditions which apply to the particular type of structure to be conditioned. A new method of analyzing summer weather data, described in this paper makes use of a frequency analysis using the three weather elements of daily maximum dry-bulb temperature, mean daily dew-point temperature and total daily radiation. The method is suggested as a basis on which engineers can select *design days*.

Summer weather records for a 10-year period in New Orleans are used to illustrate the method. Two illustrative selections of *design days* are made and hourly observations made on such days are used to compute diurnal cycles. With these cycles and the other data included, sol-air temperatures can be computed for one horizontal and for vertical surfaces of four orientations.

THE NEED for improved summer weather data for use in cooling-load estimating has prompted several analyses of weather records since the work of Albright[1] was published in 1939. His design values were based upon separate or single-element frequency analyses of dry-bulb, wet-bulb and dew-point temperatures. Sunshine and wind data were also included. In 1941 Kroeker and Soballe[2] demonstrated a method of making a two-element frequency analysis using dry-bulb and dew-point temperatures. In 1948[3] new design values of dry-bulb temperatures were published in THE GUIDE. These were based upon a frequency analysis made by the U. S. Weather Bureau covering five years of record for June, July, August, and September in over 100 U. S. cities. In 1947 a detailed analysis[4] of five years of record for Detroit was completed by the ASHAE Technical Advisory Committee on Weather Design Conditions. A two-element frequency analysis of summer dry-bulb and wet-bulb temperatures plotted on a psychrometric chart was included.

Development of the concept of sol-air temperature, which combines solar radiation, dry-bulb temperature and wind velocity in a single meteorological element, led to analyses,[5,6] published in 1945, of summer weather data and sol-air temperatures for New York City and Lincoln, Nebr. Further application of the sol-air temperature concept was sug-

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[1]Exponent numerals refer to References.
For presentation at the Oklahoma Regional Meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, INC., Oklahoma City, April 1955.

Table 1—Cooling Load Analysis — Three Different Buildings in New Orleans*

Load	Btu per hr	Percent of Total Load	Percent Due to Weather
RESIDENCE			
Transmission	29000	38.3	38.3
Solar	10200	13.4	13.4
Lights	3500	4.6	...
People	1600	2.1	...
Ventilation	31500	41.6	41.6
TOTALS	75800	100.0	93.3
OFFICE BUILDING			
Transmission	285000	3.8	3.8
Solar	340000	4.4	4.4
Lights	1408000	18.5	...
People	1687000	22.3	...
Ventilation	3840000	51.0	51.0
TOTALS	7560000	100.0	59.2
THEATER			
Transmission	63000	2.7	2.7
Solar	132000	5.7	5.7
Lights	35000	1.5	...
People	840000	36.1	...
Ventilation	1260000	54.0	54.0
TOTALS	2330000	100.0	62.4

*From Reference 7.

gested and the TAC on Cooling Load‡ recommended that data for New Orleans be studied. An analysis of these data is the subject of this paper.

Sources of Data

Dry-bulb and dew-point temperatures, wind speed and wind direction used in this analysis are from records of hourly observations made by the U. S. Weather Bureau at the New Orleans airport station. The station is located 11 miles northwest of the city at 29 deg 56 min north latitude and 90 deg 7 min west longitude. These data are for the months of June, July, and August and cover the 10-year period from 1932 through 1941, the same period of record used for analysis of the New York and Lincoln data. The solar radiation data were observations made by Drs. H. S. Laurens and H. S. Mayerson at the Tulane University campus, as hourly and daily totals of direct and diffuse radiation incident upon a horizontal plane. Measurements were made with an Eppley pyrheliometer, located on the roof of a laboratory building approximately 100 ft above sea level in an atmosphere relatively free of smoke and dust.

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Selection of Summer Design Conditions

Ordinarily, it is not economical to provide sufficient cooling capacity to maintain indoor design conditions under the worst possible weather conditions that might be encountered in a given locality. Usually somewhat less severe weather conditions are selected as a design basis, so that indoor dry bulb and humidity will exceed their design values on a few days during the cooling season. The frequency with which this can be tolerated influences the selection of design weather conditions.

Selection of design weather conditions is also influenced by the type and use of the structure to be air conditioned. The proportion of the total system load that can be attributed only to the weather varies from one installation to another. Moreover, different weather elements have varying degrees of importance in the weather's effect on the load.

This point is illustrated by cooling load analyses of typical buildings in New Orleans made by Everetts[7] (See Table 1). In the example of the residence in that table, the cooling load attributable to the weather constitutes about 93 percent of the total load. The dry-bulb temperature and sun (transmission and solar) account for 51.7 percent while the wet-bulb temperature and wind (ventilation or infiltration) account for 41.6 percent. On the other hand, of the total load on a theater cooling system, the weather accounts for about 62 percent, of which 54 percent (ventilation) is attributable to the wet-bulb temperature.

Finally, the selection of design conditions depends upon the thermal capacity of the building. Large internal thermal capacity introduces time lags and damping effects in the conversion into cooling system load of instantaneous rates of heat gain due to sun and DB temperature.

It, therefore, appears that design weather conditions are best selected by the design engineer after he has made a critical study of each case. With this in mind a multi-element frequency analysis was made from which an engineer can select an appropriate *design day* for his case.

Frequency Analysis

Method of Analysis: Weather for a one-day period was defined by the maximum dry-bulb and the mean dew-point temperatures for the day and the total solar radiation incident upon a horizontal plane during the same day. Dew-point temperatures were used because wet-bulb temperatures were lacking. The latter would have been preferable.

Details of the analysis are as follows. For each day when the maximum dry-bulb temperature was 90 F or greater, the maximum dry-bulb temperature, the mean dew-point temperature and the total solar radiation incident upon a horizontal plane were tabulated. Arbitrary ranges for each of the three values were then chosen and the tabulated data were classified. A 3-deg range in dry-bulb and mean dew-point temperatures and a 400 Btu per (sq ft) (day) range in solar radiation were used. Obviously, other ranges could be used. (In a recent analysis of summer dry-bulb temperatures Court[8] used a 5-deg range.)

Results of Analysis: Analysis of the New Orleans data by this method led to the three-element frequency distribution given in Table 2. Various statistics of interest can be determined from this table. For example, there were 32 days in all, or three per season, when the maximum dry-bulb temperature exceeded 95 F, regardless of mean dew-point and total solar radiation. These days occurred more frequently with middle values of solar radiation than with extremely high or extremely low values, and most of them occurred with mean dew-points in the 73-75 F range. Other analyses can be made from Table 2 by the engineer and proper weight can be given to air enthalpy (a function of wet-bulb temperature), solar radiation and dry-bulb temperature to suit each design.

Note that there are 421 days, or 45.6 percent of the period, represented in Table 2 with maximum

dry-bulb temperatures of 90 F or greater. There are an additional 5.3 percent of days not included because of lack of solar data but for which the maximum dry-bulb temperature was 90 F or greater. In this period the maximum observed dry-bulb temperature was 101 F, the maximum dew-point was 85 F and the maximum wet-bulb was 86 F.

A fourth weather element, wind velocity, should be included as a design condition. Study of the records showed that the 421 days included in Table 2 were about equally divided between days when the average wind velocity was between 4 and 6 mph and days when the average was between 6 and 8 mph. These differences are small, so that it was concluded that, for New Orleans, a fourth element need not be included in the frequency analysis. This might not be true for other locations.

From a load estimating viewpoint, wind velocity operates in two ways. An increase in wind velocity increases infiltration and so increases loads. Opposed is the fact that an increase in velocity increases the heat carried *away* from a surface which has absorbed solar radiation.

Example of Selecting Design Conditions

A three-element frequency analysis of the type given by Table 2 provides the design engineer with sufficient information to make his own selection of design conditions for a particular building. Use of Table 2 will be demonstrated here by two *illustrative examples,* Case I, a Residence, and Case II, a Theater.

Case I—Residence: The cooling-load estimate for a residence would seem to require the selection of a combination with fairly high values of all weather elements, with emphasis on dry-bulb temperature and solar radiation. Consider the combination of 93-95 F dry-bulb and 73-75 F mean dew-point temperatures coincident with total solar radiation in the range of 2000 to 2400 Btu per (sq ft) (day).

Examination of Table 2 shows that there were 32 days with maximum dry-bulb temperatures above the 93-95 F range, 53 with solar radiation above the 2000-2400 Btu per (sq ft) (day) range and 70 days with mean dew-points above the 73-75 F range. However, the combination was exceeded in severity only 32 times or 3 days per season. For example, on 7 of the 32 days the mean dew-point was in the 73-75 F range and solar radiation in the 2000-2400 range, but maximum dry bulbs were greater than the 93-95 F range. In all, the combination was equalled or exceeded in severity 57 times or an average of six days per season. Hence, a selection of design conditions which combines 93-95 F dry-bulb temperature, 73-75 F mean dew-point temperature and 2000-2400 Btu per sq ft total daily solar radiation, might be judged suitable for this case. These same conditions should also be suitable for load calculations for rooms on the sunny sides of an office building.

Case II—Theater: Table 1 shows that the weather factor of the cooling-load estimate for a theater is mainly the wet-bulb temperature (excluding internal load). Sun effects are of minor importance. Hence, the main factors to be considered are dry-bulb and dew-point temperatures.

Table 2—Three-Element Frequency Analysis of Summer Weather Data for New Orleans
(For months of June, July and August, 1932 through 1941)

Tot. Solar Radiation on Horizontal Plane Btu/(sq ft) (day)	Mean Dew Point F deg	Number of Occurrences Days			Total Days	Percent of Period
		Max Dry Bulb, F deg				
		90-92	93-95	>95[a]		
More than 2800	61-63	1			1	0.11
	64-66	1			1	0.11
	67-69	1		2	3	0.33
	70-72		3		3	0.33
	73-75	1		2	3	0.33
	76-78				..	..
Total days		4	3	4	11	
Percent of period		0.44	0.33	0.44		1.21
2400-2800	61-63				..	..
	64-66	2			2	0.22
	67-69	3	1	1	5	0.54
	70-72	3	1	1	5	0.54
	73-75	7	16	2	25	2.72
	76-78	3	2		5	0.54
Total days		18	20	4	42	
Percent of period		1.95	2.17	0.44		4.56
2000-2400	61-63	1			1	0.11
	64-66	3	3		6	0.65
	67-69	10	6	1	17	1.85
	70-72	11	6	1	18	1.95
	73-75	19	25	7	51	5.55
	76-78	1	3		4	0.44
Total days		45	43	9	97	
Percent of period		4.90	4.67	0.98		10.55
1600-2000	61-63		1		1	0.11
	64-66				..	..
	67-69	5	1		6	0.65
	70-72	10	6		16	1.74
	73-75	42	24	6	72	7.83
	76-78	8	13	1	22	2.39
Total days		65	45	7	117	
Percent of period		7.06	4.90	0.76		12.72
1200-1600	61-63				..	..
	64-66				..	..
	67-69	4			4	0.44
	70-72	8	6	1	15	1.63
	73-75	44	13	3	60	6.52
	76-78	13	11	3	27	2.93
Total days		69	30	7	106	
Percent of period		7.50	3.26	0.76		11.52
Less than 1200	61-63				..	..
	64-66				..	..
	67-69				..	..
	70-72	5			5	0.54
	73-75	28	2	1	31	3.37
	76-78	6	6		12	1.31
Total days		39	8	1	48	
Percent of period		4.24	0.87	0.11		5.22
Totals for all values of Total Solar Radiation	61-63	2	1		3	0.33
	64-66	6	3		9	0.98
	67-69	23	8	4	35	3.80
	70-72	37	22	3	62	6.74
	73-75	141	80	21	242	26.38
	76-78	31	35	4	70	7.61
Total days		240	149	32	421	
Total Percent		26.09	16.20	3.49		45.78

[a]Figures in this column are for temperatures above 95.

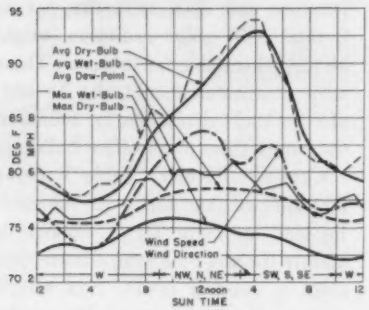

Fig. 1—Dry-bulb, dew-point and wet-bulb temperatures, wind speed and wind direction at New Orleans for Case I weather conditions

Table 2 shows that dew-points in the range 76-78 F occurred 70 times in the 10-year period or 7 days per season on the average when the maximum dry-bulb was 90 F or greater. Days with dew-points in the 76-78 F range coincident with a maximum dry-bulb temperature in excess of 95 F occurred only 4 days in the 10-year period, but there were 35 days when the dry-bulb temperature was in the 93-95 F range, and 31 when maximum dry bulbs were in the 90-92 F range. Conservatism would probably dictate selection of the 93-95 F range to be used with the 76-78 F dew-point range. High solar intensities rarely occurred with high dew-point and a selection of a range as low as 1200-1600 might be judged adequate for use in load calculations.

Diurnal Cycles

It should be evident that to be of maximum use, design conditions should go beyond a statement of how often a certain value, or a combination of single values of several elements, is likely to occur. This is all that Table 2 shows. Design conditions should also include *diurnal cycles* that are associated with the selected design values. Hence, an attempt to develop these cycles for the two illustrative examples was made.

Case I — Temperatures: This case has dry-bulb temperatures in the 93-95 F range, mean dew-point in the 73-75 F range, and total solar radiation in the 2000-2400 Btu per (sq ft) (day) range. Cycles were prepared by averaging hourly values of the days in this category. The results are shown as curves in Fig. 1 and as values rounded off to the nearest whole number in Table 3.

Table 3—Summer Dry-Bulb, Dew-Point and Wet-Bulb Temperatures at New Orleans, Fahrenheit Degrees
(For the Period 1932 through 1941)

Sun Time	Average Conditions						Maximum Observed
	Case I			Case II			
	Dry Bulb	Dew Point	Wet Bulb	Dry Bulb	Dew Point	Wet Bulb	Dry Bulb
1 a.m.	79	73	76	79	75	76	87
2	78	74	76	79	75	77	85
3	78	74	75	79	76	77	85
4	78	73	75	80	76	77	85
5	78	74	76	80	75	77	84
6	79	74	76	81	75	77	85
7	80	75	76	82	76	77	90
8	83	76	77	84	77	79	92
9	84	76	78	86	78	80	94
10	85	76	78	87	79	80	94
11	87	76	78	89	79	81	96
12	88	76	79	90	79	81	97
1 p.m.	89	75	79	92	77	80	97
2	91	75	79	93	76	80	98
3	92	75	79	92	76	80	98
4	93	75	78	91	76	80	99
5	92	74	78	88	76	79	101
6	90	74	78	85	76	77	99
7	86	74	77	83	75	77	96
8	83	73	77	81	75	77	92
9	81	73	76	80	75	76	88
10	80	72	76	79	75	76	89
11	80	72	76	79	75	76	89
12	79	72	76	79	75	76	88
Avg.	83.8	74.2	77.0	84.1	76.2	78.1	..
Daily Range	15	4	4	14	4	5	..

The dry-bulb curve is similar to the curves of individual days. As might be expected, the averaging process yields a lower daily range for the average curve, 15 deg, as compared to 16.5, the average of the individual daily ranges. The maximum in the set of days selected was 19, the lowest 14 deg.

The daily range of the dew-point curve, four Fahrenheit degrees, is two degrees lower than the average daily range. The maximum range was 10, the minimum four. The maximum dew-point in this combination was 78 F, the minimum was 68 F.

The wet-bulb temperature curve of Fig. 1 was determined by averaging hourly values of computed wet-bulb temperatures. The maximum hourly value for the days averaged was 80.5 F, the lowest was 71.3 F. The curves made up of straight-line segments give the temperatures for the day with highest wet-bulb temperatures of the 14 days averaged.

Case I — Wind Speed and Direction: Hourly wind speed and direction for Case I are shown in Fig. 1. The 24-hr average speed of 5.5 mph is only a little less than 10-year averages of 6.2, 5.8 and 5.6 mph for June, July, and August, respectively. The maximum daily average for the Case I combination was 6.0 mph and the minimum was 3.5 mph. It is of interest to note the coincidence of change in wind speed with change in wind direction. Data such as these would be particularly significant in the application of natural ventilation, though local differences may be more important than these characteristics of a single location.

Case I — Solar Radiation: The solar radiation records were in the form of *totals of solar radiation* received on a horizontal plane in one hour's time. Each total was listed under the hour for the end of the period. Hence, each value represented approximately the *intensity of radiation for the mid-point of the one-hour period*. Totals for each hour of the Case I days were averaged and plotted. A smooth curve resulted, from which intensity values in Btu per (hour) (square foot) were taken. These values are plotted in Fig. 2 and listed in Table 4. Also listed in Table 4 are maximum hourly intensities in June, July and August.

Computed values of the direct and diffuse components for a horizontal

surface are shown in Fig. 2. Values of vertical-surface total incident solar radiation have been computed with these data as a starting point and are given in Table 5. Fig. 2 also gives the *clear atmosphere* values for a horizontal surface computed from Table 4, Chapter 13 of THE GUIDE 1954. Note that the radiation received per day on a square-foot horizontal surface is 2558 Btu for a clear atmosphere, or 19 percent more than for Case I conditions.

In order to compute the intensity of radiation on vertical surfaces, it was necessary to know the direct beam component of the total solar radiation which falls on the horizontal surface. Research[9] at the ASHAE Research Laboratory has developed a method by which these components can be determined for cloudless skies. Comparison of the Case I total of 2154 Btu per (sq ft) (day) was made with an analysis of cloudless day totals by Fritz.[10] He showed that June, July, and August totals for New Orleans on such days were 2510, 2440 and 2240 Btu (sq ft) (day). Therefore, it was concluded that the total of 2154 represents, on the average, a day of little cloudiness. Consequently, the ASHAE cloudless day data on diffuse radiation were used in determining solar radiation components for New Orleans. Sun positions corresponding to August 1, 30 deg north latitude and 90 deg west longitude were used in these computations.

Case II — Diurnal Cycles: Fig. 3 illustrates average dry-bulb, dew-point, and wet-bulb temperatures for Case II, which represents days with maximum dry-bulb temperatures in the 93-95 F range, mean dew-points in the 76-78 F range and total solar radiation in the 1200-1600 Btu per (sq ft) (day) range. Values rounded off to the nearest whole number are listed in Table 3. The dry-bulb curve of this figure would be similar to that of Fig. 1 if it were shifted two hours to the right. The dew-point and wet-bulb curves of Fig. 3 could be roughly approximated by adding two degrees to the corresponding curves of Fig. 1. Whether or not the differences in corresponding curves are significant can be learned only by examining more data. Wet-bulb and dry-bulb temperatures for that day in this combination, which had the highest wet-bulb values, are shown for comparison. The main differences in wet-bulb temperatures occur between 11:00 a.m. and 6:00 p.m.

Values of total solar radiation for Case II are shown in Fig. 2 and listed in Table 4. Total radiation received of 1476 Btu per (sq ft) (day) is about 69 percent of the Case I total. The 24-hour average wind speed was found to be 5.9 mph, not significantly greater than for Case I. The maximum daily average was 7.3 mph, the minimum was 4.5 mph.

Table 4—Summer Intensity of Total Solar Radiation Incident Upon a Horizontal Surface at New Orleans
(For the Period 1932 through 1941)

Sun Time	Average Conditions		Maximum Observed		
	Case I	Case II	June	July	August
	Intensity in Btu per (hr) (sq ft)				
6 a.m.	18	18	76	101	52
7	67	54	154	165	110
8	127	92	239	220	192
9	184	135	282	283	258
10	231	166	344	341	305
11	255	184	375	376	338
12	264	202	385	382	355
1 p.m.	269	196	393	369	348
2	255	164	384	366	320
3	207	123	340	325	296
4	151	80	286	241	218
5	91	47	229	191	144
6	35	15	134	122	96
Approx. Total, Btu per (sq ft) (day)	2154	1476	3621	3482	3032

Table 5—Total Solar Radiation Intensities (Diffuse Plus Direct) on Horizontal and Vertical Surfaces for Case I Combination of Weather Conditions Compared
(For August 1, 30 deg north latitude)

Sun Time	Surface Orientation				
	Hor.	N	E	S	W
	Btu per (hr) (sq ft)				
6 a.m.	18	21	58	7	5
7	67	23	123	15	11
8	127	29	169	25	17
9	184	29	165	43	22
10	231	31	134	62	28
11	255	33	85	74	32
12	264	35	37	80	37
1 p.m.	269	32	31	77	90
2	255	28	27	64	149
3	207	25	22	43	191
4	151	28	17	21	211
5	91	41	10	12	197
6	35	36	5	5	122

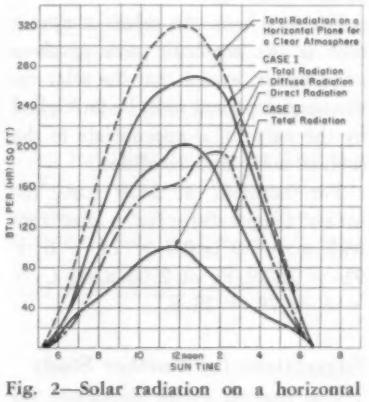

Fig. 2—Solar radiation on a horizontal plane at New Orleans for Case I and Case II weather conditions

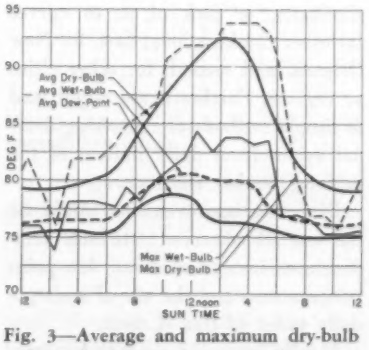

Fig. 3—Average and maximum dry-bulb and wet-bulb temperatures and average dew-point temperatures at New Orleans for Case II weather conditions

Sol-Air Temperatures

Heat transfer into the weather side of a building surface is a result of a complex energy exchange between the building surface and the outdoor environment. Heat-transfer calculations are further complicated by periodic variations of the various weather elements, but they can be greatly simplified by application of the concept of the sol-air temperature.[11] This temperature can be used to compute the heat flow into a building surface and is defined by Equation 1 (see Reference 12):

$$t_o = [\alpha I/(h_o + h_r)] + [\epsilon (R - \sigma T_o^4)/(h_o + h_r)] + t_o \quad \ldots\ldots\ldots\ldots (1)$$

where

$$h_r = \epsilon \sigma (T_s^4 - T_o^4)/(t_s - t_o)$$

and where

α = absorptivity of the building surface for solar radiation, dimensionless.

ϵ = emissivity of the building surface for low-temperature radiation, dimensionless.

per (hr) (sq ft) (F deg) for h_r and 2.50 for h_c. The low temperature radiation component was evaluated

Table 6—Components of Sol-Air Temperatures for Horizontal and Vertical Surfaces for Case I Combination of Weather Conditions, Fahrenheit Degrees

Sun Time	Dry Bulb Component	Horizontal Surface		Vertical Surfaces				
		Solar Radiation Component[a]	Low temp Radiation Component	Solar Radiation Component[a]				Low Temp Radiation Component
				North	East	South	West	
1 a.m.	79		−5					−2
2	78		−5					−2
3	78		−5					−2
4	78		−5					−2
5	78		−5					−2
6	79	5	−5	6	16	2	1	−1
7	80	19	−6	6	34	4	3	0
8	83	35	−6	8	47	7	5	0
9	84	51	−6	8	46	12	6	0
10	85	64	−6	9	37	17	8	0
11	87	71	−6	9	24	21	9	0
12	88	73	−6	10	10	22	10	0
1 p.m.	89	75	−6	9	9	21	25	0
2	91	71	−6	8	8	18	41	0
3	92	58	−6	7	6	12	53	0
4	93	42	−6	8	5	6	59	0
5	92	25	−6	11	3	3	55	0
6	90	10	−6	10	1	1	34	0
7	86		−6					−1
8	83		−6					−2
9	81		−6					−2
10	80		−6					−2
11	80		−6					−2
12	79		−5					−2
24-hr avg.	83.8	24.9	−5.7	4.4	10.2	6.1	12.9	−1.0

[a]This component is evaluated for $\alpha = 1.0$ and must be multiplied by the value of α appropriate to the surface color and condition.

σ = Stefan-Boltzmann constant = 0.173×10^{-8} Btu per (hr) (sq ft) (F deg abs[4]).

h_o = convective conductance at outdoor surface, Btu per (hour) (square foot) (Fahrenheit degree).

I = incident solar radiation, Btu per (hour) (square foot).

R = incident low-temperature radiation from the outdoor surroundings, Btu per (hour) (square foot).

t_e = sol-air temperature, Fahrenheit degrees.

t_o, T_o = dry-bulb temperature of outdoor air, Fahrenheit degrees and Fahrenheit degrees absolute, respectively.

t_s, T_s = temperature of building surface, Fahrenheit degrees and Fahrenheit degrees absolute, respectively.

Equation 1 shows that the sol-air temperature consists of three components as follows:

1. An equivalent temperature for the short-wave solar radiation absorbed by the surface.

2. An equivalent temperature for the long-wave low-temperature radiation exchange with the outdoor surroundings.

3. The dry-bulb temperature of the air.

Sol-Air Temperatures for Case I: Components of sol-air temperatures for Case I weather conditions are listed in Table 6 and are based upon average values of 1.10 Btu by adaptations of Equations 4 and 6 of Reference 12.

For any hour *the sol-air temperature is the algebraic sum of three components*, except that the solar radiation component must be multiplied by the value of α appropriate to the surface color and condition.

For example, at 2:00 p.m., the sol-air temperature for a flat roof with $\alpha = 0.9$ is $0.9 \times 71 - 6 + 91 = 148.9$ F; at 2:00 a.m., $t_e = -5 + 78 = 73$ F.

Suggestions for Further Study

The diurnal cycles developed for two different combinations of weather elements raise questions as to their similarity, or lack of it, to curves for other combinations; first, for New Orleans, and second, for other cities or regions. Further study might lead to simple methods of expressing diurnal cycles from daily indices of the various weather elements.

Desirable improvements would be the use of observed wet-bulb temperatures instead of mean dew-point temperatures and the use of a simple daily index of this element.

Finally, attention needs to be given to the possibility of design conditions chosen from a frequency analysis such as Table 2 being exceeded in severity for a large number of days in one season. Such an example occurred in June 1936, when there were 25 days on which the maximum dry-bulb temperature was 90 F or greater and the total solar radiation was in excess of 2400 Btu per (sq ft) (day). On 11 of these days, the total was in excess of 2800, accounting for all of the values in the highest bracket of solar radiation in Table 2.

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Pressure Losses of Divided-Flow Fittings

By S. F. Gilman*, Syracuse, N. Y.

SUMMARY — A critical evaluation is made of the nature of the pressure losses in divided-flow fittings and of the methods of analysis previously used. Available data for the straight-through section are compared and the poor agreement indicates the need for further research.

Analysis is made of the diverted-flow section of extended-plenum fittings and the behavior of the loss coefficient curves is explained in a rational manner. Application of concepts developed yields a predicted equation for the pressure loss which is in excellent agreement with experimental results. Some of the practical aspects of the results are presented.

AIR DUCT systems are comprised of sections of straight pipe joined by fittings which can be classified as either the through-flow or the divided-flow type. The abrupt contraction illustrated in Fig. 1 is typical of through-flow fittings. For engineering purposes the loss of head in this fitting is expressed by the Carnot-Borda equation

$$H = (V_1 - V_2)^2 / 2g \quad \ldots\ldots\ldots (1)$$

in which

H = loss of head, feet of fluid.
V = mean velocity at cross section designated by subscript, feet per second.
g = acceleration due to gravity, feet per (second) (second).

This equation generally appears in the form

$$H = [(1/C_c) - 1]^2 V_2^2/2g \quad \ldots\ldots (2)$$

where C_c is a *coefficient of contraction* which depends on the ratio of the downstream and upstream areas; *i.e.* A_2/A_1. For air conditioning systems the volume rate of flow of air in each portion of the duct system is usually known in advance. Therefore, once the size and shape of a through-flow fitting is selected, the pressure loss can be evaluated from engineering data available in the literature, together with the continuity equation for constant density,

$$Q = AV \quad \ldots\ldots\ldots\ldots\ldots (3)$$

in which

Q = volume rate of flow.
A = cross section area.

A typical divided-flow fitting is illustrated in Fig. 2 and in contrast with the through-flow type, the continuity equation involves three cross sections; thus

$$Q_u = Q_b + Q_d \quad \ldots\ldots\ldots\ldots (4)$$

As indicated by the broken line in Fig. 2, a streamline can be envisioned as separating the flow that is diverted into the branch, Q_b, from the straight-through flow, Q_d. The shape of such a streamline and its point of contact with section u, over which the velocity is constant, will vary with the proportion of the total flow Q_u diverted into the branch. Since the flows on either side of the streamline have different histories, the mechanical energy per unit mass at section b will not necessarily be equal to the corresponding quantity at section d. Consequently, it is necessary to consider the energy dissipation in the diverted and straight-through portions separately.

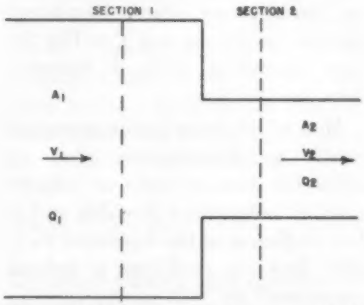

Fig. 1—Abrupt contraction, a typical through-flow fitting

Another distinguishing characteristic of divided-flow fittings is that the pressure loss is a function of the ratio of *two* characteristic velocities or flow rates; consequently, compared with the through-flow fitting the divided-flow type involves one additional variable. This was demonstrated experimentally by Vogel[1] and by Holl[2] and Konzo[3] through dimensional analysis as well as experiments.

Considerable research on divided-flow elements has been conducted by Thoma and his associates at the *Munich Hydraulic Institute*. Water was used as the fluid and the investigations were restricted to elements having a main pipe of the same size and shape at cross sections u and d in Fig. 2. Vogel[1,4] reported an investigation of various right-angle pipe tees; Petermann[5] and Kinne[6] reported studies of 45 and 60 deg oblique-angled pipe branches, respectively. Other reports of experiments utilizing water are those concerning the Boulder Dam[7] and a power station in Switzerland[8]. McNown and Hsu[9] have presented a theoretical treatment in which conformal mapping is utilized to determine the characteristics of divided flows. Concerning types of divided-flow fittings common to air conditioning, laboratory investigations have been reported by Korst[10], Holl[2] and Konzo[3], as well as in a series of 12 reports issued by the U. S. Navy[11].

Although considerable research has been conducted, the behavior of the pressure loss curves has yet to be suitably explained. Also, the results of the several investigators often appear to be in poor agreement. Although this poor agreement is partially due to differences in experimental results, it is also partially due to the different bases used for expressing the results. Sufficient information now appears available so that the behavior of the loss curves for the di-

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[1]Exponent numerals refer to References.

verted-portion of the total flow can be explained in a rational and conclusive manner. In addition, the probable best relation expressing the pressure loss in the straight-through section can be indicated, although the available data are not nearly as extensive. Since the two flows in the divided-flow fitting must be considered separately, that in the straight-through section is considered first.

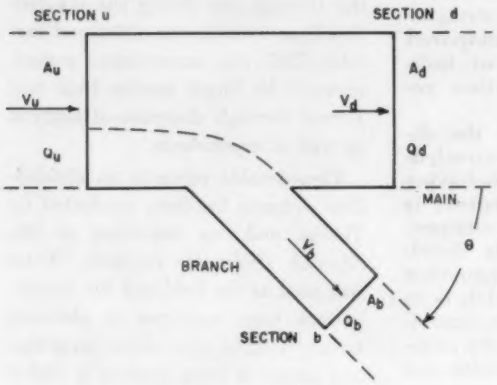


Fig. 2—Typical divided-flow fitting

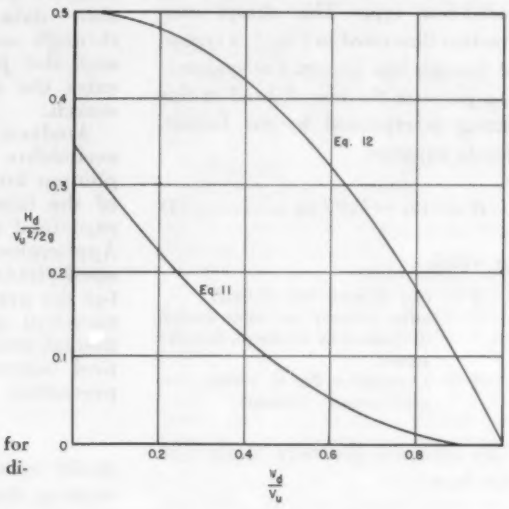


Fig. 3—Comparative results for straight-through section of divided-flow fitting

Straight-Through Section

Of the two flows, that in the straight-through section is the less complex because in continuing down the main (see Fig. 2) it does not experience the change in direction that the flow into the branch does. Moreover, the area at section d is ordinarily equal to that at section u or somewhat less, but rarely is the reduction so great that V_d exceeds V_u. Hence the flow in the main is almost invariably a retarded flow, whereas the flow in the branch can be either retarded or accelerated with respect to V_u depending upon the proportion of the total flow at section u diverted into the branch.

The usual expression for the loss of head in the straight-through section is

$$H_d = [P_u + (V^2_u/2g)] - [P_d + (V^2_d/2g)] - {}_uF_d \quad \ldots\ldots(5)$$

in which

P = static head at measuring station at designated cross section, feet of fluid.

${}_uF_d$ = nominal loss of head due to friction in the pipe section between sections u and d, feet of fluid.

It should be noted in Equation 5 that the nominal friction loss ${}_uF_d$ is deducted from the difference in total heads; hence, H_d is considered to be concentrated at the section at which the main and branch pipes join. The head loss is thereby expressed on the conventional *no length* basis, which has the advantage of permitting direct comparison of results by different investigators whose measuring stations (sections u and d in Fig. 2) were located at different distances from the junction.

Most of the investigators expressed results as dimensionless plots of either the flow-rate ratio or velocity ratio as independent variable and a *loss coefficient* as the dependent variable. This loss coefficient is defined sometimes[11] as

$$\lambda_d = H_d/(V^2_d/2g) \quad \ldots\ldots(6)$$

and sometimes[1] as

$$\lambda'_d = H_d/(V^2_u/2g) \quad \ldots\ldots(7)$$

Hence, care must be exercised in interpreting results as the loss may arbitrarily be referred to either the upstream or downstream velocity head.

Comparison of the reports of Vogel[1,4], Petermann[5] and Kinne[6] shows that a single curve can be used to closely represent their results. This means that the loss of head in the straight-through section is independent of the size of the branch and its angle with respect to the main. Such a curve is given by the parabola

$$H_d/(V^2_u/2g) = 0.35\ (Q_bQ_u)^2 \quad \ldots\ldots(8)$$

The physical significance of this equation can be made clear by expressing it in a different form. By the continuity equation (Equation 4) it is possible to express (8) as

$$H_d/(V^2_u/2g) = 0.35\ [1 - (Q_d/Q_u)]^2 \quad (9)$$

or, since the areas at sections u and d are equal,

$$H_d/(V^2_u/2g) = 0.35\ [1 - (V_d/V_u)]^2 \quad (10)$$

which simplifies to

$$H_d = 0.35\ [(V_u - V_d)^2/2g] \quad \ldots\ldots(11)$$

Comparison of this equation with the Carnot-Borda equation for abrupt expansion given by Equation 1 shows that the loss of head in the straight-through section of the divided-flow element is 0.35 of the Carnot-Borda loss for the same velocities.

Equation 11 is based on experiments using water as the fluid. For the flow of air in ducts the commonly used equation is, when expressed in

general units of feet of fluid flowing,[12,13]

$$H_d = 0.5\ [(V_u^2 - V_d^2)/2g] \quad \ldots\ldots(12)$$

This equation is not equivalent to Equation 11 and generally yields considerably larger values of loss for similar flow conditions. Comparative values are shown in Fig. 3. It should be noted that Equation 11 is restricted to the condition $A_u = A_d$ whereas the source[12] of Equation 12 imposes no restrictions on the respective areas. However, the latter equation is not valid for $V_d > V_u$ since a negative result would be obtained. The work of Konzo[3] indicates the factor 0.5 in Equation 12 is very conservative for the majority of flow conditions, and that it ordinarily varies from 0.25 to as low as 0.05.

From the Navy reports[11] covering a wide range of branch angles for round and rectangular ducts, a representative value for the straight-through section for branching angles between 30 and 90 deg is

$$\lambda_d = 0.25 \quad \ldots\ldots(13)$$

which again indicates the loss is essentially independent of the size and shape of the branch and its angle with the main. These reports also illustrate the caution which must be exercised when interpreting results of various investigators. Detailed examination of the laboratory data shows that Equation 13 includes the nominal friction loss between measuring stations separated by approximately four feet of duct. When this loss is deducted in accordance with Equation 5, the value reduces from 0.25 to 0. Since the tests were conducted with equal velocities in the 8-in. diameter upstream and 5.5-in. diameter downstream cross sections of the fittings, the latter agrees with that which would be obtained from Equations 11 and 12.

Since the flow along the main does not experience the change in direction that the flow into the branch does, the pressure loss in the main would ordinarily be expected to be less than that in the branch. This is clearly shown by the Navy tests[11] conducted with the fitting shape of Fig. 4. For branching angles of 90, 60, 45 and 30 deg, the straight-section loss is 14, 23, 39 and 58 percent, respectively, of the head loss in the branch. Thus, in the case of the more commonly used fitting (90 deg branch) the straight-through section is very efficient in comparison with the branch section.

From the present state of knowledge, Equation 11, which predicts the lower loss, appears to best represent the actual flow conditions in the straight-through section of divided-flow fittings.

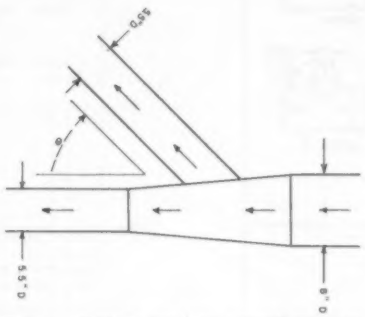


Fig. 4—Fittings used in several tests by U. S. Navy

Diverted-Flow Section

As with the straight-through section, the loss of head in the diverted-flow section is a function of the flow-rate ratio Q_b/Q_u or the velocity ratio V_b/V_u. Consequently, the loss in the branching section also involves one more variable than through-flow elements. Referring to Fig. 2, the ratios are related by the equation

$$Q_b/Q_u = (A_b/A_u)(V_b/V_u) \quad \ldots\ldots(14)$$

The use of velocity ratio as independent variable has been found to provide better correlation than the flow-rate ratio[3,14,15]. Therefore, the flow configuration in terms of the velocities in the immediate vicinity of the entrance apparently contributes most to the formation of the entrance loss.

For the fitting illustrated in Fig. 2 the loss of head is given by

$$H_b = [P_u + (V_u^2/2g)] - [P_b + (V_b^2/2g)] - {}_uF_j - {}_jF_b \quad \ldots\ldots(15)$$

in which

${}_uF_j$ = nominal friction loss in the pipe section between u and the junction of the branch pipe, feet of fluid.

${}_jF_b$ = nominal friction loss in the pipe section between the junction of the pipe and section b, feet of fluid.

Hence, the loss is expressed on the *no length* basis.

The loss coefficient used in compiling the data in dimensionless form is sometimes[2] defined as

$$\lambda_b = H_b/(V_b^2/2g) \quad \ldots\ldots(16)$$

and sometimes[7] as

$$\lambda'_b = H_b/(V_u^2/2g) \quad \ldots\ldots(17)$$

Therefore, as with the straight-through section, care must be exercised when interpreting the results of different investigators.

Typical results for the diverted flow are presented in Fig. 5. The original data have been transposed from the Boulder Dam report[7] with the abscissa changed from Q_b/Q_u to V_b/V_u by application of Equation 14. Comparison of the curves shows that the conical entrance to the branch yields much lower values at the higher velocity ratios. That both curves join at the point $V_b/V_u = 0$ and $\lambda'_b = 1.0$ is significant because it leads to intuitive reasoning that the behavior of the curves can be explained in a rational manner.

The End Point $V_b/V_u = 0$

Consider the fitting shown in Fig. 6*a* which has a branch oriented at some angle θ. The given flow conditions represent the limiting case of no flow in the branch; *i.e.*, the branch damper is completely closed. The branch then acts as a static-pressure tap connected to the main. The pressure head in the branch is

$$P_b = P_u - {}_uF_j \quad \ldots\ldots(18)$$

and Equation 15 reduces to

$$H_b = V_u^2/2g - V_b^2/2g - {}_jF_b \quad \ldots(19)$$

However, since there is no flow in the branch the last two terms disappear and we have

$$H_b = V^2_u/2g \quad \text{.....(20)}$$

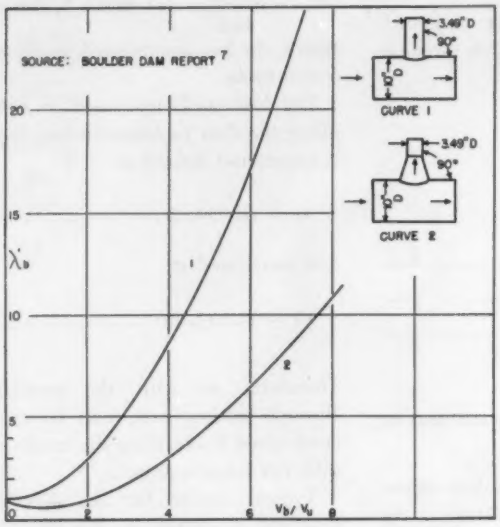


Fig. 5—Loss coefficient (λ'_b) of the diverted flow for two divided-flow fittings

and from Equation 17,

$$\lambda'_b = 1.0 \quad \text{.....(21)}$$

which agrees with Fig. 5 at $V_b/V_u = 0$, the condition for which Equation 21 applies.

That this result could be predicted was evidently not realized when the Boulder Dam report[7] was formulated, because at $V_b/V_u = 0$ the empirical equations given in the report yield 0.8 and 0.5 for curves 1 and 2, respectively.

The End Point $V_b/V_u = \infty$

Having considered the limiting case $V_b/V_u = 0$, attention is now turned to the other limiting case of $V_b/V_u = \infty$ which is illustrated in Fig. 6*b*. If the diameter of the main is very large, V_u becomes, essentially, zero. The loss of head at the junction is then equivalent to the loss of head in a pipe entrance flush with the wall of a quiet reservoir. According to Weisbach[16] this loss is

$$H_b/(V^2_b/2g) = 0.50 + 0.30 \cos\theta + 0.23 \cos^2\theta \quad \text{....(22)}$$

in which

θ = branching angle as defined in Fig. 6.

From this equation and Equation 20 the two end points of the branch curves for fittings of the geometry shown in Fig. 6 can be determined. It now remains to explain the shape of the curves connecting these end points.

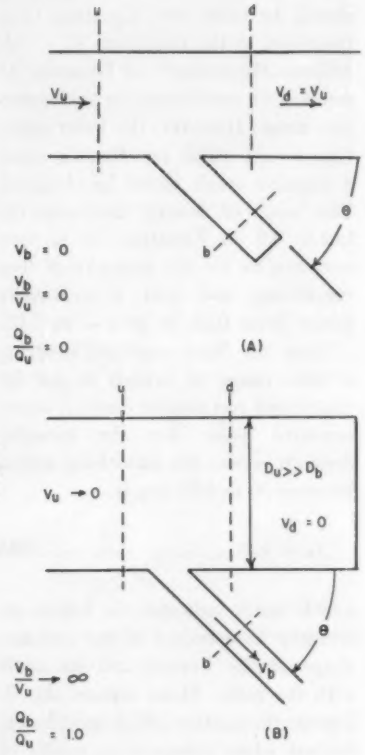


Fig. 6—Limiting conditions for divided-flow fitting

The Condition of Minimum Loss

Typical curves relating velocity ratio to the loss coefficient defined by Equation 16 are presented in Fig. 7. The area ratios are the same but the branching angles are different. Since curve 1 does not have a minimum whereas the others do, and since curves 2 and 3 cross, the initial impression would be that no particular correlation could exist between them. However, it can be shown that they have a logical behavior.

First, from Equation 22 the loss coefficient at $V_b/V_u = \infty$ increases as θ decreases. The values at this limiting condition are represented by the correspondingly numbered dotted lines in Fig. 7. Since they are in the reverse order of the curves originating at the upper left, the curves must eventually cross. Consequently, the crossing of curves 2 and 3 is an explainable behavior.

It can also be deduced that the curves should have minimums. Consider a main pipe having a small aperture from which a stream issues at some angle θ. If the flow is presumed one of constant mechanical energy the velocity diagram will be that shown in Fig. 8. Here V_u is the component in the direction of the axis of the main. The velocity corresponding to the static pressure gradient, $\sqrt{2g(P_u - P_b)}$, is normal to V_u. Since the resultant is V_b the velocity ratio is simply

$$V_b/V_u = 1/\cos\theta \quad \text{.....(23)}$$

Therefore, there is a *natural* angle of discharge associated with each value of velocity ratio. The relationship is shown graphically in Fig. 9. When this natural angle coincides with the angle of the branch, an optimum condition, and hence a point of minimum loss, should be expected.

From Equation 23 or Fig. 9, anticipated minimum values for the curves of Fig. 7 are ∞, 2.00 and 1.41 for the angles of 90, 60 and 45 deg, respectively. From the curves themselves, curve 1 does not have a minimum in the range of the data whereas curves 2 and 3 have minimums at

velocity ratios of 1.75 and 1.25, respectively. The agreement between the expected and actual minimums is, therefore, good.

That the actual minimums occur at somewhat lower velocity ratios than the calculated minimums can also be explained. The analysis leading to Equation 23 did not consider any change in the velocity in the main because the aperture was presumed to be very small. This condition certainly is not valid for the fittings of Fig. 7. It is, therefore, necessary to consider the effect of the size of the branch duct on the value of velocity ratio at which a minimum would be anticipated.

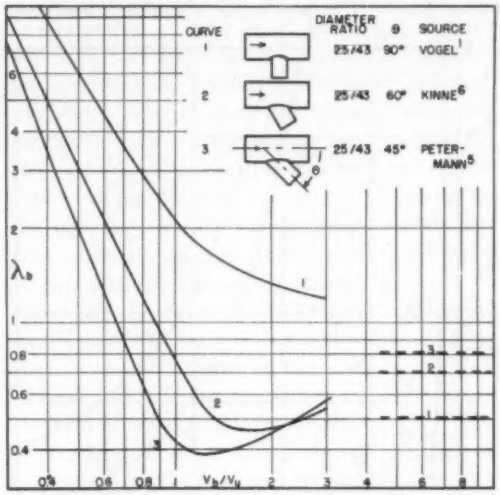


Fig. 7—Influence of branching angle θ

Referring to Fig. 2, consider the flow conditions along the entrance to the branch. At the upstream edge the velocity will be V_u, whereas the velocity at the downstream edge, V_d, will be less than V_u because the area of the main is constant and some of the flow has been diverted into the branch. Hence, along the entrance section the velocity will decrease in some manner from V_u to V_d. If the flow is one of constant mechanical energy, from Bernoulli's equation the pressure will rise correspondingly across the section. However, it is not necessary to restrict these considerations to an ideal fluid, because a velocity reduction and pressure rise will also occur with a real fluid, the difference being only the amount that the pressure will rise. With either fluid the net result is that at the downstream edge of the entrance section the velocity component of V_b along the axis of the main is less than that at the upstream edge; and the static pressure gradient, which yields the component normal to the axis of the main, is greater. As a consequence, the *natural* angle of the stream at the downstream edge is greater than at the upstream edge. The minimum loss would, therefore, be expected to occur at some angle of discharge between these two extremes, and hence at an angle greater than calculated from Equation 23. Applied to a branch duct oriented at a specified angle, this means that this natural angle and the branch angle will coincide to form a condition of minimum loss at a value of velocity ratio *less* than that given by Equation 23. As previously discussed, the velocity ratios at the values of minimum loss for curves 2 and 3 of Fig. 7 are actually somewhat less than predicted; the experimental results are therefore in agreement with this concept.

Application of this concept to divided-flow elements having the same size of main duct and the same branching angle θ, but different branch sizes, yields the conclusion that as the branch size is progressively increased the minimum values will occur at progressively lower velocity ratios. In air conditioning duct systems the branch size is ordinarily less than half the size of the main. Because of this and the fact that the slope of the loss curve will change slowly near the minimum, Equation 23 and Fig. 8 are considered of sufficient accuracy for engineering purposes.

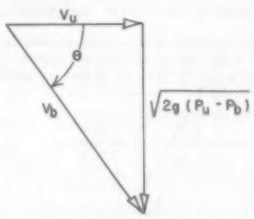


Fig. 8—Velocity diagram for flow from a small aperture

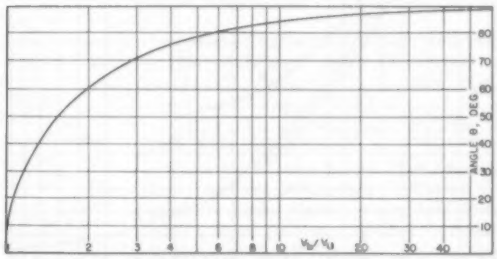


Fig. 9—Natural angle of efflux

Predicted Loss Equation

The most commonly used type of fitting is that with the branch perpendicular to the axis of the main; *i.e.*, $\theta = 90$ deg in Fig. 2. For this type, from Equation 22 the loss of head at $V_b/V_u = \infty$ is

$$H_b = 0.50\ V_b^2/2g \quad \ldots\ldots\ldots\ldots (24)$$

An expression for the loss must satisfy this condition as well as the limiting condition at $V_b/V_u = 0$ given by Equation 20. Moreover, since from Equation 23 the loss coefficient curve does not have a minimum at a finite velocity ratio, it must be either a continuously increasing or a continuously decreasing function. The simplest relation satisfying all three conditions is the sum of Equation 20 and Equation 24 because neither contributes to its opposite limiting condition. Thus,

$$H_b = 0.5\ (V_b^2/2g) + (V_u^2/2g) \ldots (25)$$

or, from the definition of λ_b given by Equation 16,

$$\lambda_b = 0.5 + (V_b/V_u)^{-2} \quad \ldots\ldots(26)$$

This relationship is shown as the dotted line, curve 4, in Fig. 10. The results of three independent laboratory investigations are also presented for comparison. Curve 1 has been obtained from the correspondingly numbered curve in Fig. 5 after converting from the λ'_b to the λ_b basis. Curve 2 shows the results of Vogel with a fitting geometrically similar to that of curve 1 but smaller (branch diameter of 0.59 in. *vs.* 3.49 in.). Curve 3 was obtained with a 12-in. x 8-in. main and a 7-in. diameter branch with air as the fluid. The agreement between curves 1 and 3, with water and air as the respective fluids, is excellent although the fittings were not geometrically similar. In addition, the agreement of these two curves with the predicted equation given by Equation 26 is remarkable and evidently validates the method of analysis applied to the right-angled junction.

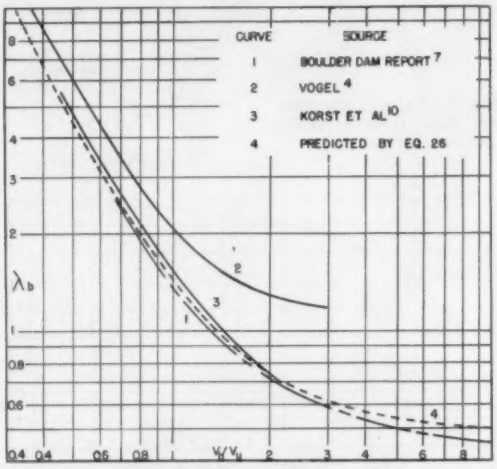
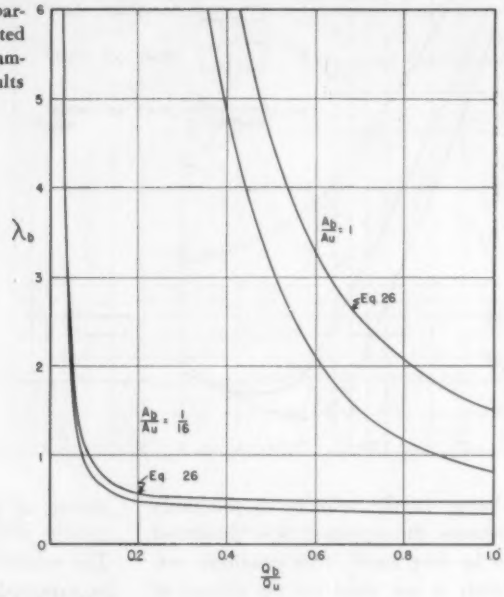


Fig. 10—Results for 90 deg branches as obtained by different investigators

Deviation of curve 2 from the rest is apparently due to a scale effect; *e.g.*, different relative roughnesses of the surfaces, resulting from the extremely small pipe sizes with which Vogel conducted his experiments. Since Korst[10] has shown that higher values of λ_b are to be expected at low Reynolds numbers, the fact that curve 2 is above the rest, rather than below, would be anticipated.

The predicted loss equation is also compared in Fig. 11 with the theoretical results of McNown[9], from which it is seen that Equation 26 yields the same shape of curve but somewhat higher values. This is to be expected because the free-streamline theory presumes that the flow is one of constant mechanical energy (no loss in total head) up to the vena contracta of the jet in the branch. Taking this into consideration, the agreement between the curves is very good, especially for the more practical area ratio of 1/16.

Fig. 11—Comparison of predicted and free-streamline theory results



It is hence concluded that Equation 26 accurately predicts the loss of head in the divided-flow fittings illustrated in Fig. 2 with a branching angle of 90 deg. For branch ducts at other angles the condition of a minimum eliminates the possibility of determining a simple analytical expression to represent the loss curves. However, for engineering purposes values for the most frequently occurring angles can be obtained from Fig. 7.

It is also evident that the flow characteristics in the diverted-flow section of such divided-flow fittings can be explained rather clearly in a rational and conclusive manner.

Practical Interpretation of Results

From the loss coefficient curves for the type of fitting shown in Fig. 2, it is possible to develop practical information for designers of air duct systems, some of which will be presented. It is hoped that a thorough treatment of the practical aspects can be given in a future paper.

For air at the standard density of 0.075 lb per cu ft, Equation 11 becomes

$$H_d = 0.35\,[(V_u - V_d)/4005]^2 \quad \ldots(27)$$

and Equation 25 becomes

$$H_b = 0.5\,(V_b/4005)^2 + (V_u/4005)^2 \quad \ldots\ldots(28)$$

where H is now expressed in inches of water and represents a loss in total pressure, and V is in feet per minute.

Consider a main of constant cross section with several branch ducts at right angles. Since a portion of the total flow is diverted into the first branch the volume rate of flow in the main, and hence the velocity, will be reduced. As a consequence, V_u is progressively less at each branch. For the same velocity in each branch,

the pressure loss in the diverted portion of the total flow (Equation 28) will also be successively less. Since the loss in the main (Equation 27) is small, if the distance between fittings is not great then the total-pressure loss of the first branch will exceed that of the combined main duct and last branch. This indicates that careful consideration should be given to the first few fittings during the design process. It also demonstrates that the commonly found instruction to *select the longest and most complicated run of duct and select the fan to overcome its pressure loss* can lead to an erroneous pressure requirement for the duct system.

That the losses in different branches may vary considerably is of particular importance to systems composed of several short branch ducts spaced relatively close together along a main. Suppose a main of constant area is to have several branches of equal lengths oriented at 90 deg to it. If the spacing between branches is small, the branch farthest downstream will have the highest flow rate while the one farthest upstream will have the lowest. On the other hand, if it were desired that each branch deliver the same cfm of air the calculations would show that the upstream branch would have to be larger than the downstream branch.

As a further practical consideration one possible way of handling the same flow rate with the same size and length of branch is to vary the branching angle.

The fact that Fig. 10 shows the pressure loss to be more than 8 *branch velocity heads* at $V_b/V_u = 0.35$ gives the impression that an extremely serious situation would exist if such low values of velocity ratio were experienced in a duct system. Such is not necessarily the case. For a given value of V_u, as V_b/V_u decreases V_b also decreases; but when the number of velocity heads *increases* rapidly the branch velocity head *decreases* even more rapidly and the net effect is the reverse of expectation. For example, with $V_u = 2000$ and $V_b = 2000$, $V_b/V_u = 1.0$ and $H_b = 0.375$; whereas for the same V_u and $V_b/V_u = 0.35$, $V_b = 700$ and $H_b = 0.280$ in. of water. Thus it is seen that even though the loss is 8.65 velocity heads for the latter case the total-pressure loss in inches of water, instead of being an expected extremely large value, is actually 25 percent *less* than that for the expected low-loss condition.

Dimensionless plots typified by Figs. 10 and 11 are of value from a research standpoint but they are not essential to the design of duct systems and tend to give misleading impressions. Equations 27 and 28 give the respective losses in total-pressure for the main duct and the 90 deg branch of the Fig. 2 fitting, and these equations furnish all the information the application engineer needs.

Conclusions

1. Analysis of divided-flow fittings is more complex than through-flow fittings because an additional variable is involved.
2. The pressure loss can arbitrarily be referred to either of two characteristic velocity heads; hence, care must be exercised when interpreting results of different investigations.
3. The behavior of the loss coefficient curves can be explained in a rational and conclusive manner.
4. Application of concepts developed yields a predicted equation for the pressure loss which is in excellent agreement with experimental results.
5. The results of the analyses provide practical information of direct aid to designers of air duct systems.

Acknowledgment

Much of the material in this paper has been taken from the author's doctoral thesis[17]. Acknowledgment is, therefore, made to Profs. H. H. Korst, W. N. Espy and S. Konzo of the Department of Mechanical Engineering of the University of Illinois, under whose guidance the thesis was written. Acknowledgment is also made to the Department of Mechanical Engineering of which Prof. N. A. Parker is Head, for permission to publish.

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THE PRESIDENT'S PAGE

The Proposed Regional Organization Plan

FOR many years the Council and the Chapter Relations Committee have discussed the desirability of a Regional Organizational Plan to provide for closer coordination of chapters within a region and to improve communications between the chapters and the Society organization.

Now that the Society has grown to 10,000 members and 59 chapters, your Council believes that a Regional Plan has become necessary for our continued growth and progress.

During the past year, the Chapter Relations Committee and the Long-Range Planning Committee made a very complete analysis of the subject, including a study of regional plans of other engineering societies. As a result, various possible plans for ASHAE were carefully considered at several committee meetings.

A plan designated as the **Regional Vice President Plan** was finally submitted to Council and to the Chapters Conference Committee at the 61st Annual Meeting. After discussion and consideration, both bodies unanimously approved it **in principle.**

The Council, therefore, instructed the Charter and By-Laws Committee to prepare By-Law changes to activate the plan and to present these changes for action at the April 1955 meeting of Council.

If two-thirds of the Council favor this proposal in April, the By-Law changes will be presented to the membership at the Semi-Annual Meeting in June, and a vote will be taken at the Annual Meeting in January 1956.

Briefly, this plan provides for the following organizational and operational arrangement:

1. The number of regions to be seven, as at present; Council to be authorized to establish regional boundaries; rearrangement of the regions to equalize, as nearly as practicable, the number of chapters per region, considering mutuality of interest and the number of members per region.

2. Election of a Regional Vice President (for a three-year term) for each of the seven regions, who would be a member of Council and whose function would be: (**a**) to act as chairman of his regional meeting; (**b**) to visit each of the chapters in his region each year; and (**c**) to transmit to chapters in his region information on important actions of Council and desired activities, such as on codes and standards, public relations, and coordination with other societies.

3. Operation of chapters by regions, through a Chapters Regional Committee in each region composed of the Regional Vice President as chairman, and a delegate and an alternate selected by each regional chapter. The Committee would meet once each year in a regional meeting with the Society President in attendance to discuss chapter operations; to review availability of chapter speakers; to elect a member of the Nominating Committee from its region; to recommend preferences of Council material to the Nominating Committee; to suggest improvement of the policies, procedures and operation of the Society; and, if desirable, to present papers or talks which would attract attendance beyond the delegate and alternate from each chapter. The travel expenses of each chapter delegate and alternate would be paid by the Society, on request. The Chapters Regional Committees would replace the Chapters Conference Committee.

4. A Regions Central Committee composed of the Regional Vice Presidents and the Second Vice President of the Society as chairman. It would coordinate the activities of the Regional Vice Presidents, consider chapter problems, coordinate the programming of regional meetings, receive and refine recommendations of the Chapters Regional Committees for submission to the Council, recommend rearrangement of regional areas, and elect to the Nominating Committee an alternate to the seven members selected by the Chapters Regional Committees. The Regions Central Committee would replace the Chapter Relations Committee.

5. The Council, as at present, would have 17 members or directors composed of the President, Past President, 1st Vice President, Treasurer, 7 Regional Vice Presidents, and 5 Directors-at-Large. The Council would be responsible for the government of the Society, and would, as at present, elect 4 members and 1 alternate to the Nominating Committee. The 5 Directors-at-Large would be elected for three years.

6. The Nominating Committee, as at present, would be composed of 11 members and 2 alternates elected by the Chapters Regional Committees, Regions Central Committee, and the Council in the manner already described.

Estimates of the cost to the Society of the plan as compared to the present operation indicate that they would not be more than present costs and would probably be less.

Your Chapters Conference Committee members have been given a detailed description of this plan including the indicated advantages and disadvantages. I suggest that you discuss this plan among yourselves and at your Chapter meetings. We will welcome your criticisms and recommendations.

J. E. Harris

President

AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS

San Francisco's beautiful and scenic Ocean Beach Drive along the shores of the Pacific

Excellent Technical Papers Planned for Semi-Annual Meeting

Technical sessions of the Semi-Annual Meeting of the Society should hold the attention of those members traveling to San Francisco to attend the meeting which will be held June 27-29 at the St. Francis Hotel. The Program and Papers Committee has worked industriously to plan a program incorporating a variety of papers dealing with subjects of general interest to the membership.

Among those subjects which will be discussed during the four technical sessions planned for Monday, Tuesday and Wednesday are Ventilation of Commercial Laundries, by Sidney Marlow; An Index for Evaluating Heat Stress in Terms of Resulting Physiological Strains, by H. S. Belding and T. F. Hatch; A Method for Determining Winter Design Temperatures, by M. K. Thomas; and Sources of Vent Gas in a Hot Water Heating System, by L. N. Montgomery and W. S. Harris. Other papers will deal with such subjects as Comparative Performance of Indirect Water Heaters, by L. L. Hill and W. S. Harris; Air Velocities in Two Parallel Ventilating Jets, by Alfred Koestel and J. B. Austin, Jr.; Resistance of Wooden Louvers to Fluid Flow, by C. W. Bevier; Psychrometric Analysis as a Means for the Design of Forced Draft Cooling Towers, by B. H. Spurlock and S. E. Agnon; and Air Conditioning Coil Odors by A. B. Hubbard, Nicholas Deininger and Frederick Sullivan.

In addition to committee meetings and the technical sessions, the San Francisco Committee on Arrangements has planned a number of special events for the pleasure of the members and their families. As a climax to the Semi-Annual Meeting, there will be a banquet on Wednesday evening in the Colonial Room of the St. Francis. B. M. Woods, past president of ASHAE and vice president, University Extension, University of California, will serve as toastmaster, and will introduce the guest speaker, A. M. Zaren, assistant director, Stanford Research Institute, Los Angeles, who will talk on *Air Pollution*.

During hours not confined to meetings and technical sessions, members and their families will enjoy visiting the many picturesque and unusual places of interest in and around San Francisco.

The Golden Gate Park is typical of San Francisco's many showplaces. It is a tract of 1013 acres created over 50 years ago by the Scotch horticulturist John McLaren. In it there are beautiful gardens, bridle paths, streams, lakes, playgrounds and groves. The Shakespeare Garden includes every flower and plant mentioned in the writings of the Bard of Avon. There is also a Japanese Garden which was created in the nineties by the Emperor of Japan and many other beautiful spectacles in this tremendous park.

A 3-day Yosemite Valley and a 9-day Hawaii post-meeting trip have been arranged. Write Golden Gate Chapter for details.

San Francisco, Calif.

COMMITTEE ON ARRANGEMENTS

June 27-29, 1955

S. W. Terry, General Chairman

G. M. Simonson, Honorary Chairman

Herbert Duncan, Vice Chairman

Banquet — N. H. Peterson, Chairman; J. E. Murray, T. R. Simonson.

Entertainment — J. I. Sprott, Chairman; Edward Hill, Jr., W. M. Lewis, J. E. Murray, C. W. Reid, Lawrence Shea.

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Sessions — D. L. Williams, Chairman; L. Britt, Leo Dwyer, G. L. Gendler, R. B. Holland, F. W. Jordan, R. C. Kelly, R. N. Poage, E. C. Sanford, C. B. Smith, J. E. Wilson.

Sports — Dudley Deane, Chairman; J. C. Beck, Jr., D. A. Delaney.

Young People's — R. C. Pribuss, Chairman; J. C. Beck, T. C. Douglas, Jr., J. F. McIndee.

Current ASHAE Research Projects

Further information concerning any of these projects is available from the Director of Research, ASHAE Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio.

Air Cleaning — Development of methods for obtaining samples of atmospheric contaminants and for measuring particle-size ranges.

Air Distribution — Flow patterns of heated and cooled air issuing into rooms from circular diffusers, ceiling plaques, annular slots, and from unit heaters.

Air Entrainment — A study of this subject in Hot Water Heating Systems; especially with extended tube radiation.

Air Friction — As in rectangular branch take-off fittings in ventilating and warm-air systems.

Combustion — A program concerned with studying and preventing pulsation noises and resonance in oil- and gas-fired heating equipment.

Comfort — What conditions of temperature, humidity, air motion and radiation are most favorable to comfort and efficiency?

Cooling — More accurate calculation of summer cooling loads in buildings by new thermal-circuit technique.

Dehumidification — The dynamic characteristics of sorbents have been investigated, and an extension of the program is in the planning stage. A preliminary performance code for sorbent-type dehumidifiers is to be tested soon.

Design Conditions — Their selection from summer weather data depends on the type of structure to be cooled.

Fan and Air Noise — A program on noises from fans and air flow is being organized.

Heat Flow Through Glass — Skylights, ordinary windows, shading devices.

Heat Pumps and Solar Heat Collectors — Sunshine as a source of winter heat for the heat pump.

Heating Load — More accurate calculation by the new thermal-circuit method.

Human Calorimeter — A new unit to measure heat and moisture losses from people.

Industrial Ventilation — Research on heat and fume removal from hot masses, hot liquids, etcetera.

Infiltration in Commercial Buildings — A program on infiltration around doors of public and commercial buildings and into multi-story buildings is contemplated.

Infiltration in Residences — Helium is used as a tracer gas to measure infiltration (and exfiltration) in residences.

Insulation — The collection and publication of reliable data on thermal conductivities of building and insulating materials.

Metastable State of Water — A study of violent boiling under special conditions.

Odor Perception — The effect of air temperature and humidity, and concentration of odorants, on the intensity of odor. A long-range program.

Panel Heating and Cooling — The development of practical design data for the engineer.

Physiological Factors — The reactions of persons to environment above and below the comfort range are to be studied in a program now being developed.

Transmission Noise — A study of vibrations in flowing liquids, resonance in piping, causes and cures.

Weather Data — Are being assembled and organized for maximum usefulness to heating and air conditioning engineers.

Discussions of Technical Papers at ASHAE 61st Annual Meeting

The First Technical Session brought out some lively discussion. It is presented here—some in abstract and some in full. Discussions at later sessions will appear next month.

Ventilation Requirements for Cigarette Smoke, by C. P. Yaglou (published in ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, January 1955, pp. 227-230).

LESTER T. AVERY, Cleveland, Ohio, asked at what point the air was brought into the test rooms and at what point it was exhausted. He felt that smoke is advantageously handled if the air is supplied from the bottom and exhausted from the top of the room.

CLOSURE: Professor Yaglou stated that just the opposite was true, as the ventilation system was downward through a perforated ceiling.

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A Rapid General Purpose Centrifuge Sedimentation Method for Measurement of Size Distribution of Small Particles, Part I — Apparatus and Method, by K. T. Whitby (published in ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, January 1955, pp. 231-237).

W. C. L. HEMEON, Pittsburgh, Pa., (WRITTEN), commented concerning the general philosophy of particle size as mentioned in the paper and stated that particle size should be regarded as a means to an end. Results of particle size distribution measurement using dispersion in a liquid might not be applicable to a study of the dust as it passes in the air through a filter. He considered that a technique described in the paper might be useful in air filtration studies, but should not be regarded as describing the effective size of the dust handled in atmospheric air filters.

W. A. CRANDALL,* New York, N. Y., (WRITTEN), stated that most methods for the determination of particle size distribution are actual measurements for terminal velocity. He believes that the method described in the paper is also of this kind. Also, he is of the opinion that the outstanding characteristic of the method is its ability to determine the distribution in the smaller size ranges, and to do so rapidly. He asked if the Brownian Motion and Cunningham's correction factor should be considered. Also, he wondered what method is used to insure that the small sample is truly representative. He also wondered whether it can be assumed that a given volume of material at one point in the capillary tube has the same weight as an equal volume at another point in the tube. He asked also whether there was any evidence of compacting since compacting might cause an error in later measurements. He observed that possible use of a stroboscope might permit continuous operation and that it might reduce the calculations and shorten the time required for an analysis.

B. L. EVANS, St. Louis, Mo., (WRITTEN), stated that there are three divisions of air cleaning technique. One is the determination of the contaminants to be removed; secondly, is a method for determining a percentage of the various sized particles to be removed and; thirdly, the design of equipment for determining the effectiveness of a filter in removing the air contaminants. He considered that the method described indicates that there is a good possibility of developing simplified test equipment sufficiently accurate for the normal commercial range.

STIC SYLVAN,† Louisville, Ky., (WRITTEN), pointed out that there are at least four methods in use for making particle size analyses, and each of them has its own special field of greatest usefulness. There is no agreement on a common method and results frequently disagree. He felt that a dust analyzer should be consistent with itself and that repeated tests should always produce the same results. He felt that the air cleaning problem must recognize smoke and dust as being two entirely different constituents of the air. He pointed out that different types of equipment are available for combatting them and that different measuring methods have been devised. He doubted if the size-frequency relationship is adequate for the smoke constituent of the air and stated that particles of colloidal size are not accessible for this type of measurement.

R. S. FARR, Los Angeles, Calif., felt that the method described in the paper is an improvement over anything available. He considered also that the method would permit us to know a lot more about particle size.

C. S. LEOPOLD, Philadelphia, Pa., stated that he believed a sample for filter performance should not be picked on the upstream side of the filter, as it is necessary to know whether the particles arrive as discrete particles or agglomerates. He asked if the author had done any work on that phase of the problem.

CLOSURE: Dr. Whitby closed the discussion by stating that he believed that many of the questions raised would be answered in Part II of the paper. He stated that at present he considers particle size analysis as an art and that it should be regarded as such, and that the art involves the interpretation of the data and the meaning attached to it. Particle size distribution is only one of a considerable number of phases involved in studying atmospheric dust. He believes that the Cunningham correction mentioned by Mr. Crandall is not great and that there are few occasions for applying it. As to the Brownian movement, he feels that it does not need to be applied. Sampling is an independent problem. One company ran forty-three analyses on a single sample of glass beads, but time did not permit him to discuss the subject of sampling. The matters of weight, volume and compaction are to be covered in Part II of the paper. There is a continuous reading machine in existence, but it is experimental. He regarded the reproducibility of this method as being below that of the Andreason, but pointed out that whether a given reproducibility is satisfactory depends on the end application of the result.

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Evaluation of Panel-Type Air Cleaners by Means of Atmospheric Dust, by H. A. Endres, W. T. Van Orman and R. P. Carter, Jr. (published in ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, December 1954, pp. 127-133).

LESLIE SILVERMAN‡ and D. M. ANDERSON,‡ Boston, Mass. (WRITTEN). This article is interesting but also highly controversial. It contains erroneous statements, irrelevant material, and misinterpretations which, in our opinion, nullify comments and conclusions the authors make in the

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text. The use of atmospheric dust as a means of testing air cleaners is not new and has been used for many years at our Air Cleaning Laboratory and by many investigators before World War II. In fact, in the literature on air cleaner evaluation there is mention of the use of atmospheric dust as a testing suspension prior to 1930. The work to which the authors refer by the U. S. Public Health Service was actually done in 1931-33 and appeared in 1936. The work was that of Ives, et al[1]. A study[2] with regard to carbonaceous content of air previously reported showed that the amount of free carbon may vary from less than 10 to 50 percent but that 25 percent on a weight basis would be a representative mean value. The ash or the inorganic material is not of negligible interest because what the housewife or maintenance personnel wipe off furniture and floors is largely the settled dust which is coarser material. A large number of fines <5 μ (microns) are present along with the larger material and by number they predominate.

The soiling power of the atmosphere has been recognized by many filter test codes which have been developed such as the original ASHVE code and the present *AFI* code; both incorporate carbon in the mixture. The National Bureau of Standards also uses an ash which contains carbon for a test suspension. For many years atmospheric dust soiling power has been used by manufacturers of air conditioning precipitators as a means of rating performance. These are usually rated on a basis of 85 to 90 percent efficiency by stain on atmospheric dust. The authors' approach could hardly be considered as a new concept.

The question of recirculation is not disputed but it must be recognized that the average home with warm air heating system will have from 1 to 2 air changes per hour, whereas a modern air conditioned establishment might reduce this value to 10 to 25 percent make-up air, depending upon the conditions involved. Because of the large amount of disturbed settled dust which is drawn into the air in a house and that which is suspended by sweeping and other activities it cannot be stated categorically that the dust should only be carbonaceous. A representative dust should be one that simulates recognized atmospheric dust composition.

The chief reason for atmospheric dust not being used as a test medium for panel-type filters in the past has largely been because of its high variability. The major objections lie in the fact that the length of time per test necessary to evaluate the holding capacity of the filter at outdoor dust loads would be impractical. This is to be borne in mind since the filter for which the test method is proposed is one which has a low holding capacity as determined by our laboratory and as the authors demonstrate by the tests reported in this paper.

Another important difficulty with atmospheric dust, in addition to its variations in concentration, particle size, and composition, which have been recognized for many years, is the fact that these variations make it difficult to test from one moment to the next unless simultaneous sampling (that is, samples up- and downstream from the filter under test) is employed or a material balance should be made with absolute filters. The authors of this paper have apparently overlooked this important factor.

The method of enrichment which the authors have proposed and used is completely uncontrolled by their method of generation. It could only be practical if enrichment were controlled so as to produce a constant air concentration and composition in proportion to the air conditions existing at the time of test.

The authors' method of producing the carbonaceous smoke is actually not capable of producing any better dispersion than trying to disperse carbon black or lamp black directly with an ejector. A highly charged and chaining aerosol is produced by burning.

The difficulty of dispersing carbon black is because a high charge is generated or produced by contact which serves to re-agglomerate the carbon even if the cohesive force of the particles is overcome.

The authors have described the use of electrostatic precipitators for collecting carbon black as employed in practice. Actually, it should be pointed out that at the present time most of the carbon black produced in this country is collected by means of cyclones followed by bag filters or cyclones followed by electrostatic precipitators. The use of the electrostatic precipitator as an agglomerator is a fairly recent innovation in the carbon black industry but has been used in at least two power plants of which the authors have knowledge, (one installation of this type is 16 years old). The purpose of this approach is to reduce the size of the precipitator necessary by using it as an agglomerator. The authors neglect the fact that agglomeration is produced by applying a voltage of 50,000 to 80,000 volts in the collector. The fact that agglomeration takes place at 8 to 10 kv voltages is proved by the fact that several low voltage precipitators use a blow-off filter in series to catch agglomerated material which may be blown off the plates in use, if an adhesive is not used on the plates.

The importance of particle size in filter testing has been emphasized in work on air cleaning for many years. The concept of fractional particle guarantees dates back to at least the early 1930's. It is established practice in power plant specifications to use fractional guarantees for mechanical collectors. In any device, depending upon impingement or mechanical collection, including filters, the particle size becomes important. The important concept, however, is not size alone, but terminal velocity which incorporates size, shape, distribution, surface characteristics, and density.

It is interesting to note that in Fig. 6, the authors state that the agglomerated material ranges from particles 150 μ to 250 μ in size. Settling velocity of such particles is so high they would not stay suspended in the air for any length of time. For example, the settling velocity for a 250 μ particle of unit specific gravity is greater than 150 fpm. Thus, selective removal in the test room would take place.

The authors state (p. 129) that only electrical forces operate effectively on particles below 10 μ. However, impaction forces are effective on particles of 1 μ and less and below 1 μ, diffusion and thermal forces operate. In fact, the most effective filter we have today, which is capable of removing 99.98 percent of 0.3 μ particles and smaller, operates with minimal electrostatic effects. The sampling filter that the authors used as their method of standardization behaves similarly. The statement fails to recognize basic principles of aerosol filtration.

Using a continuous spot analyzer sampling upstream of the filter and not downstream, the authors show that the efficiency of an impingement filter rises as high as 25 percent in Fig. 10 and then drops to nearly 0 and again rises between 10 and 18 hr. If the room is completely protected against leakage how do they account for this second rise in concentration? Furthermore, if over the period of several hours an impingement filter is operating at 20 percent efficiency it will have removed practically all of the dust in the room.

The important thing to recognize in the impingement filter coated with a viscous medium is that re-entrainment is unlikely because material caught on the filter is trapped by the adhesive and cannot escape as long as a sticky surface is available.

If the room is sealed, as indicated by the authors, calculations show that with the air sampler they employed and assuming that it is 100 percent efficient, approximately 30 percent of the room air volume is drawn through the sampling filter. Some of the efficiency of filters tested in this fashion would be influenced by the cleaning effect of the sampler itself. The room also acts as a settling chamber and the circulating fan can be an agglomerator also. The sampling pump was discharging air from the room and since it removed 1/3 of the air volume of the room over its sampling period it is obvious that at least 1/3 volume leakage was present or else a reduced pressure would result.

The authors mention that Smith and Suprenant have shown there is less variation of #4 filter paper than conventional 41. An examination of their article reveals the fact that on atmospheric dust, #41 filter paper has 26.5 percent efficiency by count whereas #4 filter paper is only 15 percent. On DOP both filters give about 23 percent efficiency. On 0.5 μ particles the comparison between the two papers is almost identical whereas on 0.6 to 0.8 μ size particles the #41 filter

[1]Ives, J. E., et al (*U.S. Public Health Service Bulletin No. 224*, 1936).

[2]A Partial Chemical Analysis of Atmospheric Dirt Collected for Study of Soiling Properties, by C. E. Moore, Robert McCarthy and R. F. Logsdon (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, October 1954).

paper is 64 percent efficient by count and the #4 paper is only 38 percent efficient. In our opinion this does not show #4 is a better paper. Both papers are made by the same process and the avoidance of numerous pin holes in either type of paper can only be done by pre-selection.

The authors make the point that their self-charging filter is an agglomerating device. Evald Anderson[3] many years ago stated that filters are agglomerating devices. Perhaps we should eliminate those filters coated with a viscous medium because any attempt to retain the particles prevents their subsequent contact by re-entrainment. Anderson showed that by passing dusty air through a bed of fibers a large number of agglomerates could be produced in the effluent air. We can show from the authors' data that dust is apparently re-entrained from their filter which they contend is superior for atmospheric dust. Agglomeration, if it exists, can be due to re-entrainment as much as to electrostatic charge. Referring to the actual multiple data tests they state that two 1 in. self-charging filters in series show an average of 77.79 percent (Fig. 14) on atmospheric dust compared to 70.08 percent (Fig. 12) for a single filter. Calculation from these data would indicate that the improvement of two in series is 7.71 percent and based on the difference between 7.71 percent and the penetration through a single filter of 29.92 percent, this makes the second filter 26 percent efficient. We believe this shows conclusively that agglomeration by the first filter does not exist to any appreciable extent. The authors' first pass efficiency data for the so-called self-charging filter confirm tests made in our laboratory and many other laboratories indicating efficiencies on the order of 10 to 15 percent which falls rapidly and is highly variable due to the low holding capacity.

If the room were sealed, as indicated by the authors and re-entrainment did not take place, why would not the air in the room become 100 percent clean within a short time? An equation which assumes that the fractional removal for each pass is the same through such a filter can be derived readily. Assuming that the dust concentration in the room is 10^7 particles per cubic foot of air with the number of air changes used by the authors, the efficiency necessary so that the dust concentration is reduced to 1 particle per cubic foot at the end of 24 hr is

$$1 = 10^7 (1 - E)^{24 \times 60/2.36}$$

The efficiency of the filter to produce this change in concentration over the 24 hr period need only be 0.4 percent. This, of course, neglects the fact that the sampling filter has also removed 1/3 of the air in the room as well as the room settling effect.

It is obvious then, that the authors' room was not tight and that re-entrainment takes place continually during a test to show a continual performance of their filter. The test on the viscous impingement filter would indicate that the dust concentration in the room is reduced because the dust caught is held on the filter and therefore the total dust level has changed.

We cannot exactly interpret the authors' computation of efficiency. If the original dust concentration in the room was used for the first measurement and all efficiencies are based on this value one result is obtained. If efficiencies are calculated on a basis of the initial value before the filter and then the test value on the next run used for the difference another value is obtained. In either case, the cumulative efficiency rises rapidly. If the original dust level is used the cumulative efficiency value rise is not as rapid.

We did not have an opportunity to comment on the authors' original paper with regard to self-charging filters but we have tested this filter in our laboratory as have many others with no evidence of any charge being generated on the filter. We have generated a charge on such fibers by mechanical friction and then tested filter performance and again we have not demonstrated any continued effect on a normal dust load in atmospheric air cleaning. In our tests clean air passing over the fibers does not create a charge at the velocity used in filtration. We would like to ask the authors, in view of the principle of conservation of energy, how they can explain the *self-charging* performance of their filter? Where does the energy come from to produce the charging? The dust level in normal air does not contain enough particulate matter to cause charging by friction against the fibers as measured in our tests. In heavy dust loadings friction charging can take place but these loadings would be in the range of process effluents or at least 1000 times atmospheric dust loadings.

If the particles in the atmosphere already contain a charge and are deposited on the filter this charge might be available but this would also be a factor in other dielectric media rather than metal filters where the charge might leak off. However, the amount of charge which the dust could hold under such conditions would be minimal and by our measurements not of significance.

We regret that we cannot concur with the authors' contention that this filter is self-charging with atmospheric loading and the velocities employed. As a mechanical filter we find that it fails to provide adequate holding capacity. The authors' tests have conclusively proved, in our opinion, that re-entrainment is taking place. The other bases for tests which the authors mention, namely, the use of height of air column and square feet of discoloration seem to offer nothing but another pair of arbitrary bases for investigators.

A. B. ALGREN and K. T. WHITBY,[□] Minneapolis, Minn., (WRITTEN): The statements in the opening paragraph and in other places in the paper, that the problem of air cleaning is largely one of removing the finely divided carbonaceous matter, is an over simplification. There is abundant evidence that any air cleaner for residential use must be designed to cope with the lint problem. Furthermore, recent particle size studies at the University of Minnesota indicate that residential dusts may contain substantial amounts by weight of very low terminal velocity fragments of fiber that have a Stokes' equivalent spherical diameter in the 3 to 10μ size range. The settling velocity of these particles is low enough so that enough of them to be a considerable nuisance could stick to vertical surfaces.

The quoted figure of 65 percent carbonaceous matter in atmospheric dust seems rather high. Recent studies by

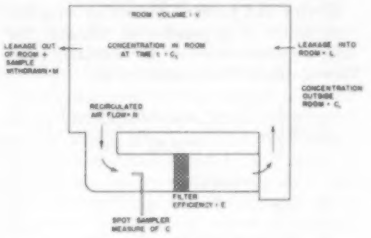
ROOM VOLUME = V
CONCENTRATION IN ROOM AT TIME t = C_t
LEAKAGE INTO ROOM = L
CONCENTRATION OUTSIDE ROOM = C_o
RECIRCULATED AIR FLOW = R
FILTER EFFICIENCY = E
SPOT SAMPLER MEASURE OF C

Fig. A—Diagram of testing arrangement

McCarthy and Moore[4] indicate an average free carbon content of about 35 percent for five different samples.

Also there is considerable evidence from dispersion studies at the University of Minnesota that a considerable portion of the free carbon in atmospheric dusts adheres to the larger dust particles under normal conditions. During sedimentation size analysis synthetic mixtures of carbon and other dusts such as fly ash and lint can always be separated in clean layers with the larger particles appearing bright and clean. However, for atmospheric dusts the particles in all but the largest size ranges appear dark gray or black.

Recent work by Dalla Valle, Orr and Hinkle[5] indicates that the aggregation in an aerosol is caused primarily by turbulence, diffusion and thermal effects. Normal electric charges on the particles affect the shape of aggregates of particles but not the aggregation rate. This is not true in the strong electric field of electrostatic precipitators where ions are present.

The source of the particles shown in Fig. 6 is not clear. Were these from an *enriched* air stream or are they normal atmospheric dust particles? What did the particles at this same station look like without the electrostatic air cleaner in the air stream?

A study of the methods and data given on the evaluation of panel type air cleaners casts doubts on the validity and usefulness of the proposed methods. There

[3]*Chemical Engineers' Handbook*, Second Edition, McGraw-Hill Book Co., 1941.

□Research Associate, Mechanical Engineering Dept., University of Minnesota.

[4]Determination of Free Carbon in Atmospheric Dust by Robert McCarthy and C. E. Moore (*Analytical Chemistry*, February 1952, p. 411).

[5]The Aggregation of Aerosols, by J. M. Dalla Valle, C. Orr, Jr. and B. L. Hinkle (*British Journal of Applied Physics*, Supplement No. 3, 1954).

are three serious objections to the methods proposed.

The first of these is the basing of the efficiencies of a test covering a period of 24 hr on a dust spot sample taken at the beginning of the test. The wide fluctuations in atmospheric dust concentration possible are clearly visible in Fig. 1. These fluctuations undoubtedly account for the wide fluctuations in apparent efficiency visible in Figs. 10 to 16.

The second and third objection can be best illustrated by a nonsteady state analysis of the data given in Figs. 10 through 14. Fig. A of this discussion shows the system described by the authors.

Rowley and Jordan[6] derived an equation from which it is possible to calculate the dust concentration in a ventilated and filtered room. This equation is:

$$C_t = \left[C_i - \frac{LC_o + D + FC_o(1-E)}{M+NE+Av}\right] e^{\frac{-(M+NE+Av)t}{V}} + \frac{LC+D+FC_o(1-E)}{M+NE+Av} \quad \text{--------(D-1)}$$

where

- C_t = concentration of dust in the room at any time t after the start of the filtration process.
- C_i = initial concentration in the room at $t = 0$.
- C_o = concentration of dust in the air outside the room.
- L = infiltration air — cubic feet per minute.
- M = exfiltration air — cubic feet per minute.
- N = recirculated air — cubic feet per minute.
- F = outside ventilation air — cubic feet per minute.
- E = filtering efficiency.
- V = room volume — cubic feet.
- A = room floor area — square feet.
- v = effective settling velocity of dust particles — feet per minute.
- D = dust concentration produced inside per minute.

For the situation represented by Fig. A, $(L = M)$ $(F = 0)$, $(D = 0)$ and it may further be assumed that the fine particles measured by the spot test have no appreciable settling velocity, $(v = 0)$. Under these conditions, Equation D-1 becomes

$$\frac{C_t}{C_o} = \left[\frac{C_i}{C_o} - \frac{L}{L+NE}\right] e^{\frac{-(L+NE)t}{V}} + \frac{L}{L+NE} \quad \text{----------(D-2)}$$

From Figs. 10 through 14, it will be noted that the apparent efficiency builds up during the first several hours. From this first part of the efficiency curves shown in the figures and from the equilibrium efficiency reached, it is possible to evaluate the unknowns in Equation D-2. In Equation D-2, there are three unknowns C_i, L and E. For the case where atmospheric dust is used as the test dust $C_i = C_o$. The two remaining unknowns L and E, can be solved for in the following manner.

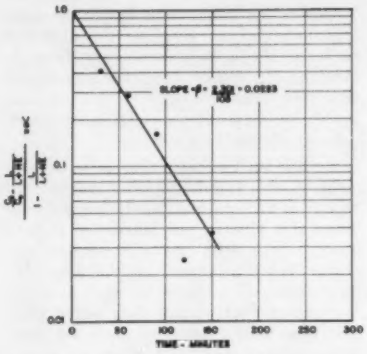

Fig. B — Values from Column 5 of Table A plotted against time

Take logarithms of both sides of Equation D-2, and obtain:

$$2.30 \log \left[\frac{\left(\frac{C_t}{C_o}\right) - \left(\frac{L}{L+NE}\right)}{\left(\frac{C_i}{C_o}\right) - \left(\frac{L}{L+NE}\right)}\right] = -\frac{(L+NE)}{V} t \quad \text{---------(D-3)}$$

It will be noted that this is the equation of a straight line on semi-log papers and is the equation that describes the first part of the efficiency curves of Figs. 10 through 14. In these figures, the ordinate called percent efficiency is actually $[1 - (C_t/C_o)]$. The quantity $L/(L + NE)$ in the left hand member of Equation D-3, can be obtained from Equation D-2, for large values of t. $L/(L + NE)$ is the value of C_t/C_o obtained after the dust concentration in the room has reached an equilibrium. It corresponds roughly to the overall average efficiency values given in the papers for each figure. However, some judgment had to be exercised in selecting C_t/C_o values from the curves to be used in the calculations because of the erratic nature of efficiency curves as a function of time. Using the value of $L/(L + NE)$ obtained in the stated manner and $[1 - (C_t/C_o)]$ values taken from the curve it is possible to calculate values of the left hand members of Equation D-3 for various times as shown in Table A. If these values are now plotted against time on semi-log paper as in Fig. B it will be seen that they fall roughly on a straight line from the origin at $t = 0$ and $\alpha = 1$. The slope of the line drawn from the origin through these points is actually the quantity $(L + NE)/V$ in Equation D-3. Simultaneous solution of these two equations yields the value of L, the infiltration rate into the room, and E the actual single pass efficiency of the filter.

The following calculation for the data of Fig. 14 illustrates how this is done. Columns 1 and 2 Table A are the data taken from the curve. From column 2 the data of column 5 were calculated. Column 5 is then plotted as shown in Fig. B. Next a straight line is drawn from the origin through the first several points and the slope determined.

Then:

$$(L + NE)/V = 0.0223 \quad \text{.....(D-4)}$$

where

$V = 2785$ cu ft.

$L + NE = 2785 \times 0.0223 = 62$ cfm

From the equilibrium conditions

$$L/(L + NE) = 0.20 \quad \text{.....(D-5)}$$

Solving Equations D-4 and D-5 it is found that:

$L = 12.4$ cfm

$E = 6.0$ percent

The results from similar calculations based on the data provided in the other figures are tabulated in Table B.

From this table two things are apparent. First, the infiltration of air into the room is high enough so that this factor rather than the filter efficiency is the most important factor in determining the apparent efficiency values shown in Figs. 10 to 14.

Second, it can be seen from Equation D-2 that the apparent efficiency as shown in the figures will become 100 percent if the leakage is actually reduced to zero. Under these conditions any filter could theoretically give 100 percent efficiency if it was allowed to run long enough.

Table B

Figure	Filter	Dust	L cfm	E %
10	1 in. Viscous Impingement	Atmospheric	60	2.8
11	½ in. Electrostatic	Atmospheric	11.2	6.6
12	1 in. Electrostatic	Atmospheric	19.3	8.2
13	1 in. Electrostatic	Smoke Enriched	10.0	3.6
14	Two 1 in. Electrostatic	Atmospheric	12.4	6.0

Table A

(1)	(2)	(3)	(4)	(5)
t Min.	% Eff. $\left\{1 - \frac{C_t}{C_o}\right\} \times 100$	$\frac{C_t}{C_o}$	$\frac{C_t}{C_o} - \frac{L}{L+NE}$	Col. 4 $1 - \frac{L}{L+NE}$
30	47	0.53	0.33	0.416
60	57	0.43	0.23	0.288
90	67	0.33	0.13	0.162
120	78	0.22	0.02	0.025
150	77	0.23	0.03	0.0375
180	80	0.20	0	0

[6]Predicting Dust Concentration, by F. B. Rowley and R. C. Jordan (*Engineering Experiment Station, Technical Paper No. 26*, University of Minnesota, 1942).

Also the data of Table B show that the actual single pass efficiency of all the filters tested is below 10 percent as would be expected. Even if liberal allowances are made for the difficulties in taking data from the curves and allowances are made for the effects of the assumptions made, it is doubtful if the single pass efficiency of any of the filters tested is above 15 percent.

The Spot Test

Calculation of the face velocity through the filter paper used in their sampler gives a value of 533 fpm. Studies at the University of Minnesota show an average efficiency by the spot method on atmospheric dust of about 50 percent for filter papers at this face velocity. Furthermore, it has been found that the efficiency varies widely from day to day as the composition of the atmospheric dust varies, especially at face velocities above 150 fpm. These two factors will introduce a further uncertainty into the significance of the data given in the paper.

Where accurate results from the spot test are desired, it is advisable to use a high efficiency filter material such as glass fiber mat or millipore filters. If the indicated or similar papers are used, they should be used at face velocities below 100 fpm and even then the efficiency should be checked occasionally by backing with a high efficiency material.

R. S. Farr, Los Angeles, Calif. (Written): This paper presents a very interesting concept of panel filter evaluation. The authors are to be congratulated on the work that has gone into securing the data for this paper and the excellent organization of the paper.

It is agreed by practically all persons working with air filters that the fine particles in the air are very largely responsible for the smudging observed. It is also known that the fine particles are the most difficult to catch by any means. The desirability of testing air filters of all kinds with a dust representative of atmosphere pollution has been recognized for some years. The authorities quoted by the authors are outstanding but other data not referred to, collected by such laboratories as the Bell Telephone Laboratory, show that the character and particle size distribution of airborne matter varies widely over the United States. This fact has discouraged many efforts to establish a test dust that truly represents all the airborne material that would approach air intake filters. This known variability makes it most difficult to compare, on the basis of atmospheric dust, one filter with another unless the two filters are tested in a number of locations scattered over the United States. For purposes of comparison, therefore, it seems reasonable to adopt a standardized test dust that will give data comparable to that shown in Fig. 5 of the paper in which performance is plotted against particle sizes in microns. With a curve such as Fig. 5 available to the user and a knowledge of local dust conditions, performance of the filter in place could be predicted.

With reference to the particles, 6μ and smaller, the authors state that they represent 99 percent of the soiling power of atmospheric dust. Work currently being undertaken by the Technical Advisory Committee on Air Cleaning may make possible the determination of filter performance of dusts in this particle size range without having to depend on day-to-day variability of atmospheric dust. Further with respect to these fine particles, the authors state that they remain airborne for long periods of time and, therefore, unless they are electrostatically activated or otherwise efficiently impinged, they should not constitute a soiling problem to merchandise or horizontal surfaces in air conditioned spaces. Facts gathered by the writer by means of adhesive coated microscope slides placed on exposed surfaces in department stores confirmed this fact in that there were no particles under 5μ observed on any of the 40 slides used. The slides were exposed for 8 to 10 days and were found to be covered with lint and a few large dust particles. Recirculated air in the space tested would have been loaded with lint and a recirculated air filter test based on the authors' proposed method would not have properly evaluated the filter for this application.

The curves of Figs. 10, 11, 12, 13 and 14 present interesting data. In the appendix to the paper, the authors state that the efficiency plotted as ordinate on these curves is determined by comparing dust spot blacknesses between the spot taken at the beginning of the test and each consecutive spot in turn. On this basis the constant efficiency of two or more consecutive S_2 spots of the same density indicates that no dust was removed from the air during that particular period of the test. A consecutive series of S_2 spots of decreasing density would show as an increasing efficiency. A consecutive series of S_2 spots of increasing density, indicating an increase in the dust concentration of the air ahead of the filter in the authors' test apparatus, would show as a decreasing efficiency on the curve. All of these conditions are present in the curves of Figs. 10 through 14 at one place or another so that careless interpretation of the curve by one unfamiliar with the details of the testing method could lead to erroneous conclusions with respect to the performance of the filter.

To make the foregoing point clear, the efficiency curve of Fig. 11 rises steadily during the first two hours indicating a continuing removal of dust from the recirculated air. From approximately hour 4 to hour 12 the curve slopes downward indicating either that the filter unloaded or that additional dust was introduced into the air stream in some other fashion. From hour 12 to hour 16 the efficiency curve rises in general indicating that the filter was again collecting dust. From hour 16 to hour 22 the curve sloped downward indicating an increase in dust concentration in the recirculated air. Since the authors state that the room was very carefully sealed, it may be that vagaries in the air currents within the room stirred up additional dust from time to time, but a test method subjected to such uncontrolled factors appears to lack the consistence of results.

The function of air filters is to remove particulate matter from the air. Recirculated air applications subject filters to artificial dusts of many kinds and concentrations. While the test proposed by the authors may provide valuable information, lack of knowledge of the dust being collected makes the test comparative for one location only.

F. Landgraf, McKees Rocks, Pa., (Written): The authors have described a means of evaluating air cleaner performance in a closed system by periodically recording the dust content in the recirculated air represented as a proportionate function of the initial dust content.

Since the recirculating system is sealed and no additional dust could enter after the run began, it is difficult to understand the negative slopes shown on the curve in Fig. 10. This curve would lead one to believe that the viscous impingement filter had twice loaded up to where it had retained approximately 25 percent of the dust in the system and twice unloaded until after 17 hr it was perfectly clean and the dust content of the system was the same as when the run began.

This seems inconceivable, since with no filter in the system at all, based on the *flotation curve* shown in Fig. 4; after 17 hr the air would have traveled about 58 mi at a maximum velocity of 300 fpm (much slower in the room) and, therefore, should have *dropped out* an appreciable portion of its dust load.

Obviously, dust *fall out* becomes a factor in any closed recirculating system. However, this factor is at best very difficult to evaluate and bears no relation to the filter under test. Therefore, a method of evaluating a filtering device including an unrelated indeterminate factor is open to question.

Arthur Nutting, Louisville, Ky. (Written): In discussing this paper, I want to refer to Fig. 11. Anything I say about this figure can be applied also to Figs. 12, 13, and 14 which report test results on synthetic fiber filters. In considering this test, we should keep in mind that we are recirculating air from an air tight room at 15 air changes an hour. A filter is in the air circuit. The room is sealed tight so dust cannot enter by accident and no dust is added in any way to the air system.

In this Fig. 11, the authors have measured the amount of dust in the air at regular periods and have compared the measurements to the quantity of dust that existed at the beginning of the test. This curve then, expresses the dust condition in the room throughout the period of test and is not an expression of filter performance. Fig. 11 does not show directly what filter efficiency is — so I would like to take the authors' data and interpret it in

the only way I think it makes sense. (see Fig. C.)

Referring to Fig. C at the first test point, 35 parts of dirt have been removed — 65 percent (the quantity above the line) remain in the air. At the 2-hr interval — 78 percent of the dust has been removed and 22 parts (the quantity above the line) of the original quantity are left in

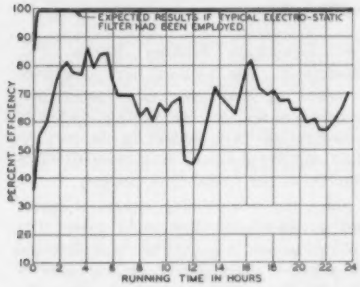

Fig. C — Equivalent of Fig. 11 of authors' paper

the air. Now, let us look at the dust condition at the 12 hr point. At this point, the air cleanliness (filter efficiency as the authors call it) has dropped from 78 to 45 percent. There are 55 parts of dust in the air at 12 hr whereas there were only 22 parts at 2 hr. After 10 hr of operation, during which time the air and dust passed through the filter about 150 times, the air is 2½ times dirtier. Now this is a test of air filter performance, and if we credit the filter for improvement in cleanliness, then we must also charge it for making the air more dirty. So, I believe it is correct to say that during this 10-hr period, the filter effectiveness is minus 150 percent. Going to the end of the test; at 24 hr, the air cleaner contains 30 parts of the original dust whereas at the 2 hr interval, it contained 22 parts. So, in 20 hr operation, the net result in room condition, is an addition of 8 parts of dust, or a minus efficiency of 35 percent. Minus because the air is dirtier.

Now, I believe it is correct to use the condition of the air at the 2 hr point as a base of comparison for the following reasons:

1. It is well known that dust particles will naturally agglomerate and by gravity settle out. This will make the air cleaner.

2. Air turbulence in a fan system will accelerate this natural agglomeration and cause more than normal dust settling, thus resulting in cleaner air.

3. Dust will impinge on all the surfaces and remain there and the authors make reference to this in their opening paragraph. This will make the air cleaner.

4. By thermal precipitation, dust will deposit on all surfaces. All these natural phenomena will act to make less dust in suspension. So, for these reasons, in a recirculation system, the room air will immediately begin to become cleaner as soon as the fan system is started and would do so whether or not an air filter were in the system.

This test method is not acceptable, but if it were, the authors should have operated the system for a period of time to allow the dust condition to come to a balance before beginning their test, and thus, eliminate the just mentioned variables. By using the condition of air at the 2 hr point interval on Fig. C, we eliminate the variables and the filter performance can be expressed more accurately. Now, I want to show you point by point how the complete curve would look with the 2 hr point used as a base.

The filter (See Fig. D) has only two points of positive efficiency because there are only two points where the air is cleaner after the second hour. The performance falls to −150 percent at the twelfth hour as explained before.

Now the efficiency can be expressed in another way, a way more usual for an engineer. That would be by expressing the

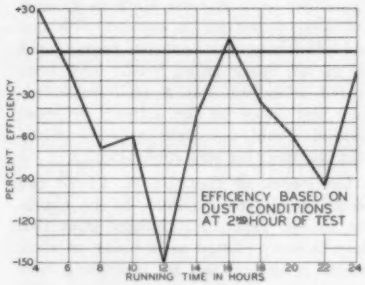

Fig. D — Efficiency based on dust conditions at second hour of test

efficiency in terms of the hour to hour change. For instance, by comparing the condition at the fourth hour with the second and the condition at the eighth hour with the sixth, and so on. This will give a performance curve for this filter as shown in Fig. E. There are as many negative points as there are positive, which agrees with the authors data, and it should be this way because there was practically no change in the cleanliness of the room after the second hour. Now I do not believe this filter added dust to the air at any time. In my opinion, the air was made dirtier during the test because the test room was not air-tight as the authors believe. I think that the dust measurements as shown in Fig. C are really a reflection of changing dust conditions in the outside atmosphere — and, if this is so, the test has no integrity.

At the 1952 Annual Meeting of the Society in St. Louis, the authors presented a paper on this same type of self-charging electrostatic filter. Since that time, some one-half dozen similar filters have been placed on the market. Air filter manufacturers have had an opportunity in the past two years to investigate all of these synthetic fiber filters and I know that they will support the statement that there is absolutely no electrostatic effect present in this type of air filter. None of us has ever been able to measure an electrostatic charge on the filters. We have tested them in every conceivable way and they do not remove smoke or in any way perform like an electrostatic filter. We have even applied electrostatic charges of 15,000 volts from the external power supply and cannot measure that the filter cleans air to any degree except in the first few minutes of operation, there may be a few percent of dust removal. If the fiber of this type filter becomes slightly coated with dust or the relative humidity raises to the order of 50 percent, the surfaces become electrically conductive and even with the external power supply, the charge will disappear and the dust removal becomes zero. If an unlimited source of energy does not force

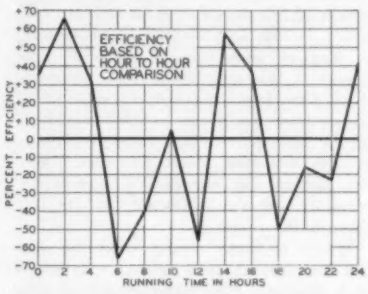

Fig. E — Efficiency based on hour to hour comparison

the filter to perform, then how can it be expected that air friction in an air conditioning system can do so?

The data expressed in Fig. C, therefore, when interpreted as it should be, support the findings of air filter manufacturers that filters of this type made of synthetic fibers have absolutely no electrostatic properties in an air filter.

These questions naturally came to mind:

1. The authors object to synthetic dusts on the ground that the small carbon particles ride piggy-back on the coarse particles. I believe this is what happens in nature; little particles join each other and little particles ride on big ones, and I ask if the authors can produce any evidence to the contrary.

2. We are acquainted with the fact that charged dust will precipitate heavily on the walls of a ventilated space. If this device charges the atmospheric dust, what would prevent the dust from being collected in the room never reaching the filter in succeeding air changes?

3. The authors have had several years to test these filters in every way and they have even devised new test methods, but what is the filter efficiency as measured by the usual methods of test such as; U.S. Bureau of Standards Method, AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS Filter Test Code or tests by the *Air Filter Institute*.

B. L. EVANS, St. Louis, Mo. (WRITTEN): This paper is well written and certainly goes to the heart of evaluating the performance of the various types of panel type air cleaners and their effectiveness as applied to the removal of the atmospheric dust which is to be found in the average industrial area.

From the results shown on various types of panel air cleaning equipment it is very obvious that some cleaning equipment is very low in efficiency, especially in the smaller sized ranges. This study correlates with the present study being conducted by

the Technical Advisory Committee on Air Cleaning and will, I believe, eventually lead to the development of a testing code so that the end user will be able to determine in advance what results he may expect from the type of filtering equipment chosen.

This paper will help point up the usefulness of present filtering equipment and help in the final determination of what a user has a right to expect when buying air cleaning equipment.

G. W. PENNEY, Pittsburgh, Pa. (WRITTEN): This paper includes a discussion of *Testing with Smoke Enriched Atmospheric Dust* and discusses it particularly as related to the testing of what the authors call *self-charging electrostatic air cleaners*. If we are testing an air cleaning device to determine the efficiency at which such a device will clean air in service, I would like to question the use of anything except the actual atmospheric air pollution. It is my opinion that the only ultimately conclusive test is one made on the air cleaner as installed in service and tested on the actual atmospheric pollution on which it must operate. Fortunately, the air pollution in most cities is sufficiently similar so that a test in one city is frequently indicative of the performance in another city. However, artificial smokes may be entirely different from normal atmospheric pollution and so, in my opinion, they should not be used for performance tests unless it can be shown that they behave like the actual atmospheric pollution to be removed.

The use of artificial smokes or dusts seems particularly questionable in the case of *self charging electrostatic* devices. Since such devices are made from high resistivity plastic materials, they can, of course, hold an electrostatic charge for a time. This may temporarily provide an electric field for precipitating charged particles, but there does not seem to be any adequate means of replacing the charge which leaks off or is used up by precipitating charged dust. There is likewise no means for charging the dust particles entering the filter.

Since the device does not provide for charging the dust entering the filter any charge on the dust as it enters the filter is vitally important. Freshly dispersed dusts usually have a strong electric charge. Likewise freshly generated smoke particles may be charged. However, atmospheric dust is very weakly charged if charged at all. James W. Hansen in his doctor's dissertation at the University of California (1948) measures the initial charge and rate of loss of charge on dust. He shows that even though the particles polluting the atmosphere may have had a charge as generated, when suspended in the atmosphere for a time these particles would lose their initial charge through the natural ionizing processes in the atmosphere.

The paper refers to *Testing with Smoke Enriched Atmospheric Dust*. In enriching atmospheric dust the smoke added usually becomes the controlling factor. My experiments indicate that benzene-alcohol smoke has unusual characteristics. Using the mixture specified in the paper and passing the smoke at low velocity through the collector cell of a two-stage precipitator with voltage on the plates but no charging voltage, this benzene-alcohol smoke could be efficiently removed. Normal atmospheric dust would not be efficiently removed under these conditions. This demonstrates the initial charge on the smoke indicating that it is not a suitable material for testing these so called *self charging* devices which have no provision for charging the dust.

Another peculiar characteristic of benzene-alcohol smoke particularly for a mixture of 50 percent alcohol and 50 percent benzene is the tendency to form chains when passing through an electrostatic field. Of course, many dusts show a slight tendency to form chains under these conditions, but the benzene alcohol smoke seems to show it to a degree that is entirely unlike normal atmospheric dust. This chain formation could explain the improved performance on recirculation since these long chains would be readily removed by any filter.

In conclusion, it is my opinion that one must be particularly careful in the testing of these filters made of plastic materials. It seems reasonable that one can readily devise a test using freshly generated smokes or dust which are initially charged and likewise handling the filter in such a way that the plastic is also charged. A high efficiency might then be obtained for a short time. However, it is my opinion that in normal operation any initial charge on the plastic will either leak off or be neutralized by collecting ions from the air so that after a short time the device must function as an ordinary filter. Any test must, therefore, accurately represent actual operating conditions in all particulars if it is to be conclusive.

W. K. GREGORY*, Louisville, Ky., (WRITTEN): My conclusion after reading this paper, is that the authors started out with the untenable premise that the prime function of an air filter is to remove particles ranging in size from 0 to 0.5 μ.

The authors state that, *the median size of the dust particles' present in normal city atmosphere during the winter months is* 0.58 μ *in diameter.*

I do not propose to question this statement, but after 31 years' experience in the air filter industry, I know for a fact that the major portion of the dust which reaches an air filter consists of much, *much* larger particles. When I entered the air filter business in 1924, the only filters which were manufactured at that time were 4 in. thick, made of steel wool or metal ferrules and coated with oil. Similar filters, somewhat improved, are in wide use today and they get good and dirty in a relatively short time in most localities.

These viscous impingement filters are the foundation on which the air filter industry was built and, as one of the many manufacturers of such filters, our company is free to admit that the efficiency we obtain on dust particles ranging from 0 to 0.5 μ is relatively low, possibly not much more than the 11.05 percent shown in Fig. 10 of this paper.

Nevertheless, with a good viscous impingement filter, you can eliminate the greater portion of the dust which would otherwise settle on walls and furniture, and for the average home or office such filters, while far from perfect, have proven adequate.

The high concentration of dust above 0.58 μ in size which is caught by viscous impingement filters is probably due to the fact that the outside air which enters them is usually taken in close to a roof or sidewalk, where winds or passing vehicles throw relatively large particles in the air. Where air is recirculated, large particles are placed in suspension by people walking about and tracking in dirt from the outside.

It is, therefore, imperative that in devising a test procedure for the evaluation of air filters, that larger dust particles which are capable of being airborne, be included in any test dust used.

The Air Filter Institute, which includes all the pioneer companies in the industry and whose members account for at least 80 percent of the dollar value of all air filters sold, has given a great amount of thought to the development of an air filter test code by which the practical value of unit air filters may be determined.

The test dust chosen has the following analysis: 25 percent K-1 lamp black, 3 percent No. 7 cotton linters, and 72 percent Standardized air cleaner test dust (fine).

Particle sizes for the K-1 lamp black range from 0.01 to 0.5 μ and fine air cleaner test dust contains 39 percent of particles in the 0 to 5 μ range, so we have a total of 53 percent of particles under 5 μ. The largest particles in this test dust are 80 μ, and only 22 percent of the particles are larger than 20 μ. According to the *AFI* code procedure, this dust is picked up from a traveling tray at a uniform rate by an air actuated aspirator and is dispersed into the duct ahead of the test filter under 60 lb air pressure. The dust fed to the filter is weighed and the dust passing the filter is caught by an absolute filter having an efficiency of 99 percent plus, after which it is weighed. Efficiency is thus accurately determined on a weight basis.

Granted that some agglomeration of the particles of lamp black does occur, and some coating of the larger particles of air cleaner test dust takes place, it is, nevertheless, evident from comparative tests with other types of dust, that the lamp black is broken up into very fine, hard-to-catch particles.

As an example, every filter we have tested has shown a lower efficiency on *AFI* test dust than on standardized air cleaner test dust (fine) alone. The air cleaner test dust contains 39 percent by weight of particles in the 0 to 5 μ range and the *AFI* dust contains only 28 percent of particles

*Continental Air Filters, Inc.

of this size plus 25 percent lamp black. This indicates that a considerable portion of the agglomerates which undoubtedly occur in the lamp black are effectively broken up by air pressure employed for dispersing the dust.

In conclusion, I would like to say that, while it is certainly desirable to remove as large a percentage as practical of dust particles in the 0.5 μ range, no air filter is practical which will not show a reasonably high efficiency when tested by the *AFI* method. Since our company manufactures a filter which employs synthetic fibers and could, therefore, be considered a *self charging electrostatic air cleaner* (although we have not used this nomenclature). I am not disposed to minimize the value and practicability of filters of this general type, for commercial reasons, if nothing else. Nevertheless, our company has taken the position that to be practical, a filter of this type should show an efficiency of at least 70 percent when tested in accordance with the *AFI* code and should have a reasonably high dust holding capacity.

LESTER T. AVERY, Cleveland, Ohio (WRITTEN): This paper on air cleaning is most interesting. Those of us who use air conditioning for ourselves and supply it to others will agree with the premise *smoke and soot should be classified with moths and corrosion as a public enemy.*

Well do we recall the early disappointments in the forced air heating system with the much-extolled filter to find we still had discoloration above grilles and continued need for paint-washing and paper-cleaning. It seems that the authors' explanation of how soot collects on more heavy particles which can be filtered out adds a little light to the question of why you get so much discoloration downstream from a filter. It appears to me that the soot may be riding along on the heavier particle, sort of a loose skin effect. This is the only rational explanation we have for the very obvious advantage of the electrostatic cleaner in holding this black material.

This paper also gives me an opportunity to comment on the basic fallacy of thinking on the part of the ordinary warm air heating industry. Somehow, somebody decided that fan operating cost was important so fans were designed with a minimum pulling power and the smallest possible motors and then put on intermittent operation. Nothing could be more disastrous to good air cleaning. If we somehow could get the manufacturers, contractors and owners to understand the problem, we would use heavier fans and quiet, put on larger motors and plan for continuous fan operation, thus getting the virtues of the recleaning that is so ably pointed out in the paper. Even a filter that is only 10 percent efficient on small particles will gradually clear them up by the repetitive process of passing through 6 or 8 times an hour and limiting the new material to what comes in by infiltration or brought in on rubbers and shoes and clothes. So I submit that, in making better filters, we must have stronger fans to handle air against higher resistances.

It also permits me to point out that ordinary air cleaning is not simple, should not be over-simplified in its selling or equipment. Good air cleaning may involve stage operation whereby we have different means to remove gases, heavy dirt and smoke and, of course, odors that do not necessarily come out with filtering the above. "Cleanliness is next to Godliness" and I think it is as true in air as it used to be in people.

Now that our Society is using a new name, AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, INC., we are taking a very serious interest in air conditioning problems and air cleaning is certainly one of them. Again thanks to the authors for this paper.

W. C. L. HEMEON, Pittsburgh, Pa. (WRITTEN): It is difficult to evaluate the significance of the recirculated air efficiency data presented in this paper because so many details of procedure and results have been omitted. The basis for evaluating the solids content of a particular filter paper sample is essentially the same as the blackness test and is basically sound, provided, however, that the electrical output of the photocell is, in fact, directly proportional to the incident light. This cannot be assumed to be true as the authors indicated was done, otherwise entirely false conclusions from test data may result where photocell and ammeter are incorrectly matched.

The mathematics in the appendix do not tell us clearly how the efficiency data were obtained from a sequence of single blackness measurements on filter paper samples all taken upstream of the air cleaning unit. It is necessary to infer that the procedure consisted of the comparison of one 25-min sample with a similar sample immediately following it, and that the ratio of the corresponding optical densities of the two samples provided the basis for calculating efficiency during that hour.

If our inference is correct we are then led to a question illustrated by the following example. In the absence of any reported test data let us assume an initial concentration of solids during a particular 25-min period of 6 COH's per 1000 ft of air, a fairly smoky atmosphere[7]. Taking 70 per cent as a typical efficiency figure, we would expect smoke concentrations to be reduced in about 3 hours to a level where the accuracy of the light transmission reading is seriously impaired. We are, therefore, unable to understand how it was possible to obtain satisfactory measurements for periods up to 24 hours in length unless outdoor polluted air was admitted to the test chamber at intervals. Perhaps the authors failed to emphasize that the atmosphere was enriched with the artificial smoke early in the test period. In that event one might suggest that enhanced efficiencies were due to the particular character of the artificial smoke.

No evidence is reported in the paper to prove that there was no significant infiltration of outdoor air which, if it occurred during the periods, would subject the test results to the characteristic variability of diurnal changes in outdoor smoke concentrations. The scatter of data shown in the graphs, in particular the dips seen after several hours have elapsed, do, in fact, suggest the possibility of such influences.

Apart from the content of this particular paper I should like to comment on the filter testing controversy that has occupied the attention of a segment of the society for several years. In a consideration of outdoor air pollution[8] due to dust and smoke we have found it useful in clarification of the problem to make a sharp distinction between the properties and effects of coarse particles which are characterized by the ability to settle out by gravity and fine particles like fuel smoke which do not. We see no reason why the same considerations do not apply to the cleaning of air for building ventilation, and if it were recognized it would logically lead to the conclusion that there are two types of dirt to be considered—coarse dust and fine smoke. The soiling properties of each are entirely different, their origin is not the same and the difference in their size properties indicates that they cannot be measured by the same technique. From this it follows that two separate and distinct test methods are needed. The blackness test, one form of which was applied by the authors in this paper, would represent an appropriate test method for one type of soiling potential, and a weight efficiency method would be applicable to the other type. It would then be of paramount importance always to emphasize in applications that the two types of pollutant are as different in all respects as, figuratively speaking, a gas and a liquid.

C. B. ROWE, Madison, Wis. (WRITTEN): In my opinion, the basic philosophy which guided the preparation of this paper is well summed up, in a previous writing,[9] by one of the authors ..... *our philosophy is that if you can pick up the finer particles, coarser particles will take care of themselves.* In the work described in this paper, it appears that the coarse particles are left to take care of themselves. Any work which completely ignores the existence of the larger particles is of limited value.

The terms *atmospheric air* and *atmospheric dust*, from general use in the field and from the authors' paper, apply to air and its dust load as found in the out of doors.

The majority of filters that are manufactured and sold are used in such applications as home furnaces, unit heaters, and central system filter banks. Air passing

[7] Determination of Haze and Smoke Concentrations by Filter Paper Samplers, by W. C. L. Hemeon, G. F. Haines, Jr. and H. M. Ide (*Air Repair*, August 1953).

[8] Hemeon, W. C. L., Sensenbaugh, J. Deane, and Haines, George F. Jr., Measurement of Air Pollution, *Instruments*, Vol. 26, April, 1953.

[9] Self-Charging Electrostatic Air Filters, by W. T. Van Orman and H. A. Endres (ASHVE TRANSACTIONS, Vol. 58, 1952, p. 76).

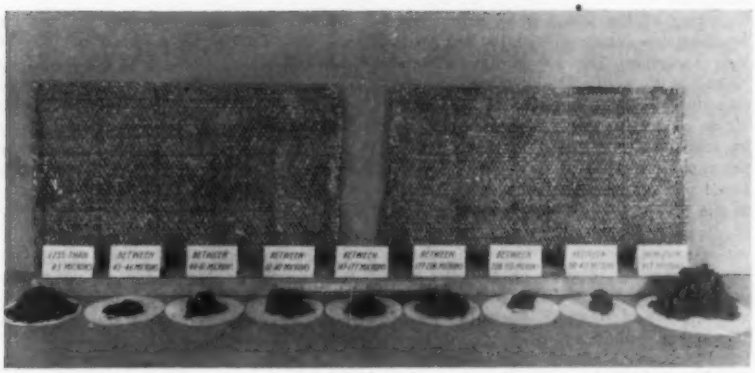

Fig. F — Size and quantity analysis of dust from two filters in an apartment house furnace

through filters used for such applications is generally 75 to 100 percent re-circulated. Only from 0 to 25 percent of the volume circulated is what is referred to as *atmospheric air;* 75 percent or more of the air is *re-circulated air.*

For purposes of discussing air filtration, I define *re-circulated air* and *re-circulated air dust* as the air and its dust load as it occurs in space used for general occupancy.

To gain some conception of the nature of the dust load in *re-circulated air* we removed a number of filters from various types of installations such as home furnaces, package air conditioners, and central system filter banks. We washed the dust load out of each of these filters with dry cleaning fluid and then collected the dust load from the cleaning fluid by filtration. The components of the collected dust were then separated by sieving. A typical analysis is shown in Table C. Fig. F shows a typical set of extracted dust specimens.

The foregoing procedure can be criticized on the basis that, (1) particles which the filter did not arrest are not accounted for, and (2) particles which the filter did arrest possibly agglomerated and thus increased the apparent particle size. However, from visual and microscopic examination of the dust particles it was very apparent that a substantial part of the total bulk was made up of particles which are vastly larger than those contained in the *atmospheric air* described by the authors of this paper. For example, all of the samples checked contained substantial quantities of lint. In our opinion, it is dust of this type which panel type filters are commonly used to collect, and in selecting a test dust, dust of this type certainly should be considered and included. We believe that the significance of the dust load in *atmospheric air* is, at most, of secondary importance.

We recognize the importance of recirculation. However, it is certainly not realistic to go on from there and place a filter testing unit in a completely sealed and presumably unoccupied room. Such a test cannot duplicate the conditions present in an occupied room. Test results, particularly if air flow resistance changes are included, obtained in an unoccupied room are of no value in predicting the performance of an air filter in an occupied room. This is especially true of the conditions of an average home involving rugs, furniture, pets, clothing, children, and opening and closing doors.

Under the heading Evaluation of Viscous Impingement Filters the authors state that efficiency values of 11.05 percent were obtained on viscous impingement type panel filters. They further state that this value is in line with the commonly accepted values obtained by present test code procedures and published by filter manufacturers. The concern with which I am connected is a major manufacturer of viscous impingement panel type filters. We do not accept nor publish such figures as representative of the efficiency of the panel type filters which we manufacture. Also, I do not know of any method having the status of a recognized *code* which will yield such results on a good panel type filter. The authors should be more specific in describing the filters and the *code* to which they are referring.

In the discussion under the heading Efficiency Versus Particle Size, the authors make the statement, *Hence, a downstream electro-static filter often picks up more dust than the upstream filter.* In inspecting the efficiency results described under the heading Evaluation of Self Charging Electro-Static Air Cleaners we note that the data plotted in Fig. 11 show an average efficiency of 67 percent and those plotted in Fig. 12 show an average efficiency of 70 percent. Those plotted in Fig. 13 show an average efficiency of 85 percent. If two of these filters are used in tandem, it is obvious that #2 filter could not pick up more dust than #1 filter if the efficiency of the #1 filter exceeded 50 percent. Consequently, if the #2 filter often picks up more dust than the #1 filter, it can only be concluded that the test results often do not apply to a filter under its working conditions. In this respect, the test method displays the same defect for which other proposed methods have been severely criticized.

It should be further noted that test results by other workers in the field do not confirm the effectiveness of panel filters, working on the "self charging electrostatic" principle off either fine or coarse[10,11] dust.

In examining Fig. 15, it is our understanding that the plot represents the progressive magnitude of the airborne dust load in a closed and sealed room where the air is being re-circulated through a filter. If this is correct, I do not understand why the air gets cleaner for the first 10 hr of running and after reaching a maximum state of cleanliness, it gets dirtier again until it reaches about the same stage of cleanliness that it had after 4 hr of running.

M. E. JACOBY,* Newark, Ohio, (WRITTEN): We do not agree with the authors that the test they propose is suitable for evaluating panel-type air cleaners. Our experience with *atmospheric dust* indicates that it is highly unreliable for testing, and that many precautions must be taken be-

Table C—Sieve Analysis of Dust Specimen Extracted from a Panel Filter used in a Department Store Central System Filter Bank

Size of Fraction in Microns	Weight of Fraction in Grams	Weight of Fraction in Percent of Total Weight	Nature of Fraction
+417	7.3	8.1	Lint, Coarse dust, Agglomerated particles.
−417 +350	1.9	2.1	Lint, Coarse dust, Agglomerated particles.
−350 +208	3.3	3.7	Mostly Lint; Few clumps Agglomerated dust particles.
−208 +177	4.2	4.7	Lint; Dust, Agglomerated particles.
−177 +147	3.6	4.0	Lint, Agglomerated dust particles.
−147 + 61	9.2	10.2	Lint, Dust particles, Agglomerated particles.
− 61 + 46	9.6	10.6	Lint, Dust particles, Agglomerated particles.
− 46 + 43	2.5	2.8	Lint, Dust particles, Agglomerated particles.
− 43	48.8	54.2	Fine Dust Particles.

*Owens-Corning Fiberglas Corp.

[10]New Developments in Air Cleaning, by Leslie Silverman, (*American Industrial Hygiene Association Quarterly,* 15:3, September 1954).

[11]Discussion, by C. B. Rowe (ASHVE TRANSACTIONS, Vol. 58, 1952, pp. 66, 74).

fore significant conclusions can be drawn from such data.

In the absence of precautions necessary for a valid comparison, supporting data should be given. For example, the dust concentration in the test room is compared with a discoloration measurement obtained before starting the test. To interpret the figures, much information is needed about this preliminary measurement:

1. Was the preliminary *comparison spot* based on one measurement or several? Were they as widely variable as the points which appear in Figs. 10-14?
2. What was the dust concentration at the start of each test?
3. What were the conditions of temperature, humidity, etc., under which the tests were run? What were outdoor dust and wind conditions? How long was the room closed before the test started?

As another example, it is stated that *in initial tests there was some air leakage into the room; however, this was later eliminated.* This is obviously an over-simplification — for one thing, 43.6 cu ft per hour were exhausted through the sampling pump. The question naturally arises as to how much leakage really occurred during each of the tests. Was it affected by outdoor wind velocities? Would this help to explain the wide fluctuations in the dust level of the room during the test?

There are other cases where questions arise; the point is, however, that much supplementary data is required for proper evaluation. Since such data was not presented, the conclusions about so-called self-charging electrostatic filters seem a little reckless.

We feel the authors' use of the word *efficiency* should be corrected. In Figs. 10-14 the ordinates should more properly be labeled relative dust concentration *vs.* running time. We are not sure of what the dust concentration is relative to, but after about an hour's running time it does not seem to decrease any more. From the authors' description, we conclude that no dust was being caught. By all past definitions the filter efficiencies would have been called zero.

L. L. Dollinger, Jr., Rochester, N. Y., (Written): In order to hasten to our comments on the test method and results, we concede most of the preliminary discussion of the difference between atmospheric and artificial dusts, the desirability in some cases of testing filters under operating conditions and the efficiency of the *single pass* type of electrostatic filter as demonstrated so aptly in Figs. 7 and 8.

We do not immediately comprehend why, after a prolonged discussion of the desirability of testing filters with outside atmospheric dust, the authors proceeded to test their filters in a room which was carefully sealed to prevent the infiltration of any outside air and airborne dust.

As we understand it, a dust spot was taken from the air in the test room at the beginning of the test and all subsequent readings were compared with the first reading. Therefore, the values which were plotted in Figs. 10 to 13 as efficiencies are actually percent cleanliness of the room air as compared with the original reading or, reading in reversed direction, one gets percentage dirtiness of the air as compared with its original condition. Without, at the moment, discussing the desirability of sketching an overall average for points which vary as much as they do in these graphs, the significance of the straight line average is that the filter did not have an efficiency of 10 or 87 percent as designated, but rather an efficiency of zero from the time at which the average efficiency was reached.

We question the significance of the overall average as indicated by a straight line because it would seem that the user of the filter would be interested in knowing the variation in efficiency from hour to hour, since the greatest smudging of protected goods or equipment would take place at points of minimum filter efficiency. We further question the significance of curves drawn through points representing average efficiencies at given running times. In some cases there is as much as a two-fold variation in the efficiencies at the same running time for three separate series of tests. It might have been more instructive to plot the curve for each series of tests separately but it is not possible to do this in the absence of published data or some means of distinguishing between points for the separate runs on the graphs. Therefore, for the sake of discussion, let us consider the graphs as drawn. Taking Fig. 12 as an example, the dirtiness of the test room is increased from 20 to 50 percent of its initial dirtiness between the seventh and the twelfth hours of running time. If one leaves out of consideration variables other than the efficiency of the filter, this means that the filter had a negative efficiency to the extent that enough dirt was blown out of the filter back into the room during this 5-hr interval to increase the dirtiness of the air to 250 percent of its dirtiness at the beginning of this 5-hr period. Wherever a curve has a negative slope, this means a negative efficiency. It would seem that it might be possible to find some kind of function involving the derivatives of these curves which would be more representative of the actual hour-by-hour efficiencies.

Mention was made of the fact that, after the beginning of the tests, leaks were discovered in the seals about the door and windows. If the readings taken during the time of leakage are represented by the horizontal row of points across the time axis in Fig. 10, they should, of course, have been omitted. The authors are not clear as to just what readings were taken under non-standard conditions.

Whereas the viscous panel exceeded its average efficiency during the first sampling period by more than 100 percent, the filter represented in Fig. 13 did not attain to its average until after more than 3 hr, corresponding to about 60 passes of the same air through the filter. A rather large number of passes was also required in the case of the filters represented in Figs. 11 and 12.

In view of the wideness of the scattering of experimental points on the graphs, we are inclined to think that all the scattering is not due to the characteristics of the filter but that probably a large portion of it finds its origin in the test method. We feel that there must have been considerable sedimentation of dust within the room during the test period and there might well have been a cycle in this sedimentation caused by a repetition of conditions as dust was deposited first in one crevice or on one protected surface and then picked up and deposited elsewhere. The cyclic nature of the conditions is indicated by the repetition of minimum at the end of 12 hr and by the striking resemblance between the various curves.

In their introductory paragraph, the authors discussed the fact that the carbonaceous matter in atmospheric dust is the portion which causes the greatest soiling or, in other words, is removed from air most readily by thermal or electrical precipitation or ordinary sedimentation. It is also well-known, of course, that soot adheres readily to most surfaces. These facts together with the observation that the percent cleanliness of the air was greater after soot was introduced seems to corroborate our previously-mentioned suspicion that this method of testing involves too many variables due to the possibility of sedimentation of dust in the test chamber.

One incidental question which comes to mind is how to account for the finite efficiency at zero running time represented by the graphs in Figs. 10, 11 and 12. Perhaps this was an oversight in plotting.

In view of the foregoing comments, we can summarize by saying that we question the validity of this method of testing filters because (1) while the filters are presumably tested with atmospheric dust, the tests are made in a room which is sealed against the infiltration of atmospheric dust, and (2) because we feel that the test conditions are such as to give variable results entirely independent of the characteristics of the filter. Even if the test method were valid, we feel that it would not be of general interest but only of interest to those who are interested in filters through which it is necessary to pass the air as many as 60 times before achieving the desired results.

Authors' Closure: During the presentation of the paper, the authors introduced an additional illustration, Fig. G, which illustrates the testing arrangement. It should be noted that no external discharge for the sampling pump is shown as indicated in Fig. A of the discussion by Professor Algren and Dr. Whitby. The air from the sampling pump was discharged into the room. Otherwise Fig. G is self-explanatory.

Professor Algren and Dr. Whitby contend that the authors' statement that the problem of air cleaning is largely one of removing finely divided carbonaceous matter, is an over simplification of the air cleaning problem and that our quoted

figure of 65 percent carbonaceous matter in atmospheric dust is high as indicated by their figure of 35 percent supported by only five samples. It is relatively unimportant whether the figure is 65 or 35 percent, but we believe most filter manufacturers agree it is important to remove carbonaceous matter from the air. Carbonaceous matter is the source of the damaging effects on walls, woodwork, drapes and merchandise, whereas, the other contaminants may be wiped off without damage.

Professor Algren and Dr. Whitby also point out that a considerable portion of the free carbon in atmospheric dust adheres to the larger dust particles under normal conditions. This is not substantiated by the performance of impingement type filters or by microscopic examination of cascade impinger test slides.

Referring to the work of Dalla Valle, Orr, and Hinkle, the statement is made in the discussion of Professor Algren and Dr. Whitby that normal electrical charges on the particles affect the shape of aggregates of particles but not the aggregation rate. We do not believe that this statement is applicable in the tests cited because we have shown visual proof that the agglomerate size is increased as a result of passing through a self-charging electrostatic filter as exemplified in Fig. 6. We know the original particle size of the carbonaceous matter was 1 μ or less, and after passing through the filter the particles became 150-250 μ in size.

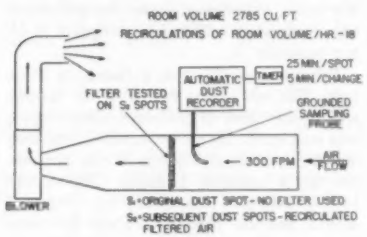
ROOM VOLUME 2785 CU FT
RECIRCULATIONS OF ROOM VOLUME/HR - 18
25 MIN / SPOT
5 MIN / CHANGE
TIMER
AUTOMATIC DUST RECORDER
FILTER TESTED ON S_2 SPOTS
GROUNDED SAMPLING PROBE
300 FPM
AIR FLOW
BLOWER
S_1 = ORIGINAL DUST SPOT - NO FILTER USED
S_2 = SUBSEQUENT DUST SPOTS - RECIRCULATED FILTERED AIR

Fig. G — Testing arrangement

The particles shown in Fig. 6 were taken from the Army Base Telephone Exchange in Oakland, California, 30 ft down stream from a self-charging electrostatic filter. These were not obtained from the enriched air stream and they are normal atmospheric dust particles. We have obtained the same type particles down stream in several other localities. We have seen numerous instances where this has occurred. Without the electrostatic air cleaner in the air stream they would be invisible.

We are glad to learn that the wide fluctuations clearly visible in Fig. 1 are recognized and we agree that they probably have a bearing on the fluctuations in Fig. 10, however, careful examination of Figs. 11 to 14 does not reflect the wide fluctuations.

We do not agree that the rate of infiltration of air into the test room is high enough that this factor rather than the filter efficiency is the most important factor in determining the values shown in Figs. 10 to 14. Fig. H shows the results of 542 tests as shown in the curve. We used an *AISI* recorder inside the room, passing a column of air 5500 ft in length through No. 4 filter paper at a velocity through the filter paper of 46 fpm. An identical recorder was used to measure the dust contained in the outside air so that simultaneous dust spots could be matched. Atmospheric dust content in terms of percent reduction of transmitted light is plotted against the filter efficiency as determined by direct comparison of matched inside and outside spots.

In order to make the tests severe and rigorous, the door to the test room was opened 174 times per day so that the infiltration of air in the room was abnormally high. Here, the overall cleanliness of the air in the room compared to the outside atmosphere, which we have termed filter efficiency, is 48.39 percent. The authors believe that this value represents abnormally high infiltration of air and compares directly with the results of Fig. 12 where the average efficiency is 70.08 percent with little air leakage. We disagree that under our test conditions any filter can theoretically give 100 percent efficiency, if allowed to run long enough. However, in each one of these tests cited there were 432 volume changes of room air passing through the test filters which should be ample time to establish the practical filter performance. Also referring to Figs. 10 to 14 we believe that the trend is clearly established that no further improvement of filter performance will be achieved by continuing the test.

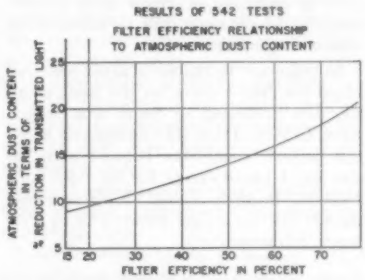

Fig. H — Curves showing relation between filter efficiency and atmospheric dust count resulting from 542 tests

(*Note:* Test room door opened 174 times per day July 26, 1954-August 24, 1954)

In Table B of the comments by Professor Algren and Dr. Whitby we come to the value of L representing air infiltration in cubic feet per minute. We note 60 cfm is the air infiltration assigned Fig. 10. It seems unreasonable that this value, which should be a constant, is 3 to 6 times higher than for the tests exemplified in Figs. 11, 12, 13 and 14. When we compare air infiltration values for Figs. 11 to 14 we find

Fig.	cfm	percent
11	11.2	1.35 of 833 cfm
12	19.3	2.3
13	10	0.8
14	12.4	1.5

Therefore, air infiltration plays only a small role in these tests.

Furthermore, we disagree with one assumption in the equation of Rowley and Jordan. The dust concentration produced inside per minute (D) does not equal zero and, therefore, casts doubt on the validity of values obtained in Tables A and B. Dust was being produced constantly by the V-belt drives on the tunnel and sampling pump. It was also known, as stated in the authors' paper, that the oil bath silencer on the sampling pump was emitting oil droplets into the air.

When the equation is simplified, the term D is present. Therefore, this value has played a major part in causing fluctuations in the efficiency curve not only the term L.

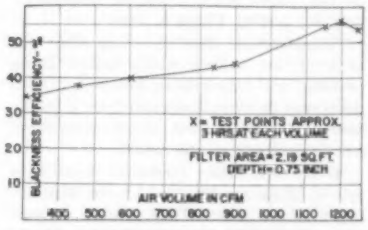
BLACKNESS EFFICIENCY-%
10
20
30
40
50
X = TEST POINTS APPROX. 3 HRS. AT EACH VOLUME
FILTER AREA = 2.19 SQ FT. DEPTH = 0.75 INCH
AIR VOLUME IN CFM
400 500 600 700 800 900 1000 1100 1200

Fig. J — Curve showing single pass blackness efficiencies at varying air volumes

Therefore, air leakage cannot be blamed entirely for the variations in Fig. 10. It is the authors' opinion that the variations shown in Fig. 10 well represent the difficulties encountered in testing ordinary viscous impingement type air cleaners on atmospheric dust.

Statement is made that it is doubtful if the single pass efficiency of any filter tested is above 15 percent. This apparently is a matter of opinion and we accept the opinion of Professor Algren and Dr. Whitby on this value. In fact, the integrated efficiency on the curve in Fig. H indicates that with low dust content in the air it is possible to achieve 15 percent, which is lower than single pass efficiency. However, since attention has been directed to single pass efficiency and values quoted, we would like to introduce Fig. J, a curve showing single pass efficiencies run on self-charging electrostatic filters at varying velocities where each test is a result of 3 hr testing on matched spots and the single pass efficiencies range from 34 to 55 percent using the National Bureau of Standards Test Method on atmospheric dust.

The authors should like to emphasize that their paper does not deal with single pass efficiencies but with the integrated efficiencies as represented by room air cleanliness.

Comment has been made on the 533 fpm velocities through the filter paper of our sampler. The authors recognize that this velocity is high and here again would like

to point out that on the curve, Fig. H, the velocity through the filter paper was 46 fpm and the results are substantially in agreement with the 533 fpm. We feel this is proof that the velocity through the filter paper does not have much bearing on the results.

The use of high efficiency filter papers is desirable but impractical due to the large number of tests necessary.

We value Professor Algren's and Dr. Whitby's comments, however, we feel air cleaning efforts should be directed toward the measurement of the inside air cleanliness just as the *Air Pollution Control Association* directs its efforts to accurately measuring outside air dirtiness.

As regards the discussion by Professor Silverman and Mr. Anderson the authors would first like to state that they do not claim that the use of atmospheric dust for testing filters is new.

Carbonaceous dust is responsible for most of the soiling which makes house cleaning and redecorating necessary. Other dusts may be more important from a public health standpoint, but these dusts were not the subject of our paper.

Accelerated filter evaluation tests with special dusts are like accelerated weathering tests on paints. They give an answer, but correlation with actual atmospheric tests is questionable. Twenty-four hours is not considered too long a time for an accurate evaluation of filter efficiency. Dust holding capacity is of secondary importance and is not the subject of the present paper.

We admit that our test procedure is a deviation from *standard practice*. This was intentional as the previous methods have been found wanting by many investigators and the authors consider that a new approach is necessary and desirable.

It is recognized that the method of testing with smoke enriched atmospheric dust needs improvement and refinement. In a previous paper[12] the authors described a method of controlling the smoke concentration and its characteristics. It was found that carbon black or lamp black cannot be dispersed with an ejector and that the carbon must be generated in situ.

Professor Silverman should check reference 9, on the Reference List of the authors' paper, p. 133, on the use of cyclones and bags before electrical precipitators. The rubber industry would certainly like to know if the manufacturers of furnace blacks are using the wrong sequence of equipment in their process.

The statement concerning 1 to 2 air changes per hour does not agree with p. 142, line 8, of THE GUIDE, 1954 — A ventilation rate between 8 and 12 changes per hour is desirable—. In the average home the recirculation may run from 120 to 240 changes per day.

[12]Self-Charging Electrostatic Air Filters, by W. T. Van Orman and H. A. Endres (ASHVE TRANSACTIONS, Vol. 58, 1952, p. 53).

The drop in Fig. 10 to low values is covered in our comments on Mr. Dollinger's discussion. The room air volume drawn through the sampler is not a factor in the filter performance because it applies equally in all cases. The discharge from the sampler was not exhausted from the room and, therefore, cannot be classified as needing replacement.

The authors disagree with the statement that, if over the period of several hours, an impingement filter is operating at 20 percent efficiency it will have removed practically all of the dust in the room. Fig. 10 shows no indication of removing all dust, only 11 percent of the total. Fig. 5 shows clearly what happens to fine particles. They go right through and few are caught even by recirculation. Hence there are fine particles which never will be captured by viscous impingement filters.

In reference to the filter paper used, we chose the No. 4 paper on the basis of all the data presented by Smith and Surprenant. In their Table III (reproduced here) the particle count was reduced more by the No. 4 paper except for the 0.6 - 0.8 μ fraction. In their Table IV (also reproduced) are the values referred to by Professor Silverman:

Count Analysis of Airborne Particles — Percent of Each Size (Table III)

Particle diameter microns	Unfiltered air	Filtered Air	
		Paper No. 4	Paper No. 41
below 0.4	31.8	45.2	47.4
0.4 - 0.6	42.6	38.1	40.3
0.6 - 0.8	16.2	14.2	9.1
0.8 - 1.0	6.8	1.9	2.4
1.0 - 2.0	1.6	0.6	0.8
over 2.0	1.0	...	...

Filtering Efficiency by Particle Size for Each of Several Air Sampling Media (Table IV)

Particle diameter microns	Flow rate of 20 fpm	
	Paper No. 4	Paper No. 41
below 0.4	23%	23%
0.4 - 0.6	22	28
0.6 - 0.8	38	64
0.8 - 1.0	79	74
1.0 - 2.0	74	70
above 2.0	100	100

Prof. Silverman seems to believe that the efficiency of the No. 41 paper is better because of his quoted values of 64 percent and 38 percent in the 0.6 μ to 0.8 μ range. But Table IV indicates that the 0.6 μ - 0.8 μ range is the only one where No. 41 outperforms paper No. 4

It is immaterial which paper is the better because the effects of the sampling are cancelled out when comparing any of the curves. Also air pollution recorders as developed by the American Iron and Steel Institute and other recorders use No. 4 paper.

The efforts to show that reentrainment influences the tests is most determined. There is no evidence of this in Fig. 10 and the high level of performance shown in Figs. 11 through 14 refutes this contention.

The reason the room does not become 100 percent clean is simple. No filter is 100 percent efficient and with this system we reach a point where the particles are of such size, shape and density as to preclude further cleaning.

Regarding single pass efficiencies see Fig. J and our comments covering the discussion by Professor Algren and Dr. Whitby.

Anyone interested in the nature, magnitude, persistence and measurement of electrostatic charges on high dielectric plastics is referred to the work of Woodland and Ziegler reported in *Modern Plastics*, May 1951, p. 102. In this paper it is pointed out that electrostatic charges on plastics can only be measured by specialized techniques. This is probably the reason why Professors Silverman and Anderson have found no evidence of any charge.

Fig. H shows clearly that with increased dust content improved efficiencies are obtained. We know from National Advisory Committee for Aeronautics tests that dust is necessary to produce electrostatic charge. Six years' experience shows the self-charging electrostatic filter has adequate holding capacity.

Reentrainment is not a factor in these tests. The use of the height of air column and square feet of standard discoloration was suggested by an outstanding authority on air cleaning and offers a new perspective on a complex problem. The authors believe that this perspective has value and should not be rejected lightly by mere statement of opinion.

In conclusion, we wish to point out again that the objective of the paper was testing panel type air cleaners by means of atmospheric dust, and was not concerned with the type of filters.

The authors agree with Mr. Farr that the use of a uniform standardized test dust for the evaluation of filter performance would be highly desirable, but such a dust must be more nearly representative of average normal atmospheric dust than any thus far devised.

The fine particles present in atmospheric dust are capable of remaining suspended in the air for long periods of time, but they do constitute a soiling problem due to electrostatic and thermal precipitation. Hence the soilage of walls and ceilings.

Mr. Farr's point on the possibility of careless interpretation of Figs. 10 through 14 is well taken and the authors hope the reader will take sufficient time and effort to clearly understand them. Recirculated air is being widely used in homes, offices, and industry today and, therefore, may properly be considered part of the problem.

The authors feel that they should correct Mr. Nutting on the number of air changes per hour. There were actually 18 air changes per hour.

Mr. Nutting's choice of the 2-hr point in Figs. 11 through 14 is seriously open to question. The air cleaning processes listed 1 through 4 apply equally well to viscous impingement filters so they too are being given equal credit for work which they did not do in cleaning air with the result that all averages are somewhat high-

er. Let us choose the 10-hr period for the discussion of Fig. 11. Here the performance is close to zero. The selection of a single point in Fig. 11 enables anyone to find what he wants to find, but here again the emphasis should be directed toward average values. In the author's 1952 paper (p. 66) we gave the Reference 2 Static Dust Collection on Plastics, by P. C. Woodland and E. E. Ziegler. In this reference on p. 15 we find this statement.

> This work has also shown that electrometer readings are valuable only when obtained and interpreted by a person completely familiar with the use of the instrument. In this respect the situation resembles that of cross-polaroids which can be used constructively to indicate certain conditions within a plastic molding, but which can be misused by the novice to indicate conditions that do not exist.
>
> Thus it is that a *neutral* condition on a molding might be indicated by an electrometer and might well be interpreted to mean that no dust will collect on that molding. The fact might be that a very high positive and negative charge, existing side by side, are balancing each other out as far as the instrument is concerned, and that unusual and heavy dust deposits might be expected in both areas.

The authors present the following answers to the three questions mentioned by Mr. Nutting.

1. The great distances smoke travels disputes the piggy back theory. Also under Mr. Farr's comments he pointed out he could find no particles under 10 μ in his sedimentation test plates.

2. The electrostatic and thermal precipitating power of the walls is insignificant compared to that of the electrostatic filter. This is shown by the cleanliness of walls and ceilings of rooms in buildings where electrostatic filters are used.

3. Fig. J gives the answer obtained by the National Bureau of Standards Method. The ASHAE filter test is now considered obsolete. No formal action of either approval or disapproval has been taken by ASHAE on the *AFI* test code.

The authors agree with Mr. Landgraf that sedimentation is a factor in this system without question. It was our purpose in introducing a control viscous impingement filter to provide a comparative level of filter performance. If we knew how to eliminate sedimentation it would reduce the levels of Figs. 10 to 14 by an equal amount, say 5 percent.

The authors appreciate Mr. Evans' comments.

In reply to the comment by Dr. Penney the authors would state that the inclusion of smoke enriched atmospheric dust tests was prompted to provide a means of testing for emergency use under conditions of unusually clean air which make testing impossible otherwise. We heartily agree the actual atmospheric dust is the best way to test air cleaning devices. Fig. H shows the long time test of sufficient number to answer Dr. Penney's thoughts on short time efficiencies. The authors recognize Dr. Penney's service in the air cleaning field and express their appreciation of his valued comments.

The authors are pleased with the agreement of Mr. Gregory to the test values for viscous impingement filters shown in Fig. 10. One of the country's outstanding authorities has said that improvement in air filtration must come in the better collection of the finer particles. Our paper suggests a test method which is a practical application of evaluation on the real problem — removing atmospheric dust. The authors have commented on the *AFI* test code many times through the *Open for Discussion* columns of *Heating, Piping & Air Conditioning*. We are not in favor of the code since it does not represent atmospheric dust.

Mr. Avery points out the need for larger fan motors to permit continuous fan operation, with which we heartily agree.

Mr. Hemeon points to the need of correctly matched photocell and ammeter. These were calibrated to insure that the electrical output of the photocell was directly proportional to the incident light.

Fig. G presented at the meeting should clarify the foundation of the mathematics used. All spots were compared to the original dust spot S_1.

Fig. 13 represents the only conditions under which the atmosphere was enriched by artificial smoke.

Every effort was made to prevent infiltration of outdoor air by sealing all crevices with masking tape to minimize the influence of diurnal and other cyclic changes of atmospheric dust content. We believe the infiltration influence has been held to a sufficiently low value so as not to appreciably affect the results of our tests. The hills and valleys of our curves may also be influenced by the discharge of the sampling pump and the v belt drive to the blower.

We believe Figs. 3, 4 and 5 illustrate Mr. Hemeon's thoughts that there is a sharp dividing line between fine and coarse particles in their behavior and properties. We suggest that 10 μ may well be considered as the boundary line. It happens to be the dividing point between visible and invisible particles which seems to add stature to this boundary. Classification of dust particles from centrifugal separators seems to fit very nicely this 10 μ dividing line. The authors congratulate Mr. Hemeon for the work he has done in the *Air Pollution Control Association* and fervently hope that his suggestion that we have a fine and coarse dust problem to be treated separately may find acceptance in the Society. We believe the fine dust problem has been neglected much too long.

It is the privilege of Mr. Jacoby to disagree with our tests, but when he indicates atmospheric dust is *highly unreliable* for testing, we believe the word should be *variable*. Atmospheric dust is the condition encountered and its removal, the objective of air filtration. The Wright Brothers were not daunted by variable wind velocities or is modern aviation completely stopped by variations of weather. Testing on atmospheric dust is not easy, but it is the problem and should be faced.

All the precautions of a research laboratory were used to guard against the many variables involved materially influencing the results. Representative dust spots were submitted but space and printing accuracy precluded their inclusion. To answer the questions listed by Mr. Jacoby:

1. The preliminary dust spot was not based on one spot and the spots were not widely variable.

2. The dust concentration at the start of each test was 25 percent reduction in transmitted light for a column of air 13,400 ft in length or a greater concentration.

3. The temperatures were 77 F, humidity was not controlled. The outdoor dust and wind conditions were isolated by sealing the room. The room was open 24 hr before each test run and the door closed and sealed immediately after the S_1 spot.

The 43.6 cu ft per hour discharge from the sampling pump was discharged into the sealed room and, therefore, may not be considered as being replaced by leakage.

The supplementary data exemplified on Fig. H should do much to satisfy the requirements of this method of testing. This was covered in our answer to the comments of Professor Algren and Dr. Whitby.

Figs. 10-14 represent the effectiveness in cleaning the air and, therefore, may properly be called efficiency. It should not be confused with single pass efficiencies. Seventeen times in the text we have mentioned recirculated air and we believe no one can misunderstand our intentions.

With reference to the remarks of Mr. Rowe, the authors believe, as Mr. Hemeron has pointed out, that the problem of cleaning air is a two-step problem, one of fine particles and one of coarse particles. Our paper covers atmospheric dust and the measuring technique emphasizes fine particles. We note in Table C and Fig. F of Mr. Rowe's discussion that under 43 μ are classified as fine particles. We submit that 10 μ and less is a better classification. The sealed room is an excellent research approach enabling a control of variables not possible before. Fig. H shows what happens in an occupied room. Mr. Rowe questions the value of 11.05 percent being in line with viscous impingement tests. We can cite at least one case. The authors recall that in a booth of a filter manufacturer in the 1953 ASHAE show there was a display of filter efficiencies. Using the Bureau of Standard Test Method that manufacturer showed 5 percent efficiency for various impingement filters.

Regarding Mr. Rowe's comments on the paper which two of the authors presented in 1952, we refer to the TRANSACTIONS ASHVE, Vol. 58, 1952, pp. 75 and 76.

Regarding the comments of Mr. Dollinger, the authors point out that in their test method they allow the test chamber to become full of atmospheric dust in normal concentration. Then the chamber is sealed off to prevent atmospheric variations from affecting the results. By this step they can control the variables more closely. This is simply good research procedure.

The average efficiency as shown in Figs. 10 through 14 is the index of performance of the filter from the start to finish of the

test. The point to point efficiency after the average line is reached is zero, but this average line serves as a yardstick in evaluating the overall performance of the filter.

Hourly variations in efficiency are of little use to anyone. In choosing a filter for your own use would you choose a filter with an overall average of 10 percent or one with 70 percent? Hourly variations mean little by themselves. Also it is not a matter of maximum smudging power at minimum efficiency, for it happens during the summer months that the efficiency is close to zero yet the atmosphere is exceptionally clean and has less smudging power than at other times — Fig. H exemplifies this fact.

The negative efficiencies referred to in Fig. 12 are not due to the filter performance alone. Therefore, any comment involving only a segment of the curve is as useless as taking a word out of text. Fig. H should clarify any hourly variations.

Leakage was discovered during the initial test runs; however, no such data is included in the paper.

The time involved in reaching the overall average is of little significance. The curves were meant to represent how well the air has been cleaned. The overall averages speak for themselves.

The so-called wide scattering of points in our curves as mentioned by Mr. Dollinger is caused by several factors. Because the room was sealed off, it was difficult to control temperature, pressure, and relative humidity. By increasing the number of filters as shown in Fig. 14 and in further tests with 3, 4 and 5 filters in depth the points were not widely scattered. It has been our experience that panel type filters exhibit cyclic performance, and all this cannot be blamed on the method.

In referring to sedimentation Mr. Dollinger misquoted our words. The term the authors used was *sedimentation after flocculation*, not *ordinary sedimentation*. The particles of the soot were too small to allow them to settle out. Agglomeration occurred first so the particle became large enough to be captured.

Concluding our comments, we like the truly automatic method of recording dust concentrations and credit should be given to the *Air Pollution Control Association* for making this development possible. That group tells us how dirty the air is outside and by applying the same method we can measure the cleanliness of air of spaces intended for human occupancy.

It is our hope that the reader will not believe we have provided all the answers to the problem but we do feel gratified by the interest and number of comments received from so many noted authorities in the air cleaning field.

Summary of Chapter Meetings*

• *BALTIMORE*: *Legal Comments for Businessmen and Engineers* was the subject of a talk by W. W. Cahill, Jr. given at the January meeting. Speaking from his knowledge as an attorney, Mr. Cahill gave several examples where carelessness in regard to legal contracts caused considerable trouble, and emphasized the proper procedure to avoid such difficulties. J. K. Wolford, chairman of the program committee, introduced the speaker.

The presentation of a Life Membership Certificate was made by Pres. E. H. Taze to W. E. Gray. Attendance 45.

• *BRITISH COLUMBIA*: At the third annual University of British Columbia Night held on January 12, the British Columbia chapter acted as host to 24 fourth-year mechanical engineering students and four professors from the Department of Mechanical Engineering at the University. The feature of the evening was a panel discussion. J. M. Bird, moderator, introduced his fellow chapter members, S. C. Gale, R. D. Hale, C. W. Leek and D. M. Drake, representing sales engineers, manufacturers, contractors and consulting engineers, respectively. The panel replied to questions submitted by the students prior to the meeting.

It was found that the discussion not only provided an interesting meeting, but also gave the students an insight into the possibilities in the heating, ventilating and air conditioning profession. On behalf of the students and faculty Prof. F. W. Vernon thanked the chapter members for their invitation, and added a few personal observations. Attendance 67. Attendance ratio 0.45.

• *CENTRAL NEW YORK*: A number of members and guests had the opportunity to visit a test residence in Syracuse prior to the meeting on January 19.

L. A. Childs introduced two guest speakers from Carrier Corp., Syracuse, R. A. Barr, engineer, Unitary Equipment Division, and S. F. Gilman, senior research engineer, Research Department. They gave an apt presentation of their subject, *Residential Air Conditioning*, in question and answer form. Attendance 60. Attendance ratio 0.30.

• *CENTRAL OHIO*: A chapter member was the speaker at the January meeting, which followed a dinner hour. H. G. Hays, chief engineer, Armstrong Furnace Co., Columbus, Ohio, told of developments in warm air heating, giving predictions for the future. Attendance 74. Attendance ratio 0.52.

• *CONNECTICUT*: L. E. Pelletier introduced the January speaker, Lewis Smith, C. A. Dunham Co., who gave a lecture, accompanied by slides, covering the design of steam heating systems for housing projects, based on projects he has covered for several insurance companies and private investors, as well as the New York Housing Authority. The talk covered operating methods and results.

D. M. Hummel presented a Life Membership Certificate to I. C. Jennings. Attendance 68. Attendance ratio 0.38.

• *DELTA CHAPTER*: On behalf of the *Louisiana Engineering Society*, J. V. Reuter, Jr. announced at the January meeting that January 20 to 26 had been designated as Engineers Week.

J. S. Burke reported on the brochure being prepared for presentation to ASHAE headquarters regarding the invitation to hold an Annual Meeting in New Orleans in January 1960.

Introduced by Theodore Offner, technical papers chairman, G. E. May served as arbitrator of a panel on *Residential Air Conditioning*. Brief talks on different phases of the subject were given by J. T. Knight, Jr., J. S. Adair, J. C. Young, J. D. Maddox, T. J. Jenny and Ralph Elizardi.

• *EMPIRE STATE CAPITAL*: A sound moving picture, entitled *Please Pass the Condensate*, was presented in January by J. F. Curran, New York Sales Office, Yarnall-Waring Co. Following the moving picture, Mr. Curran conducted a question and answer period. Pres. E. C. Doyle introduced the speaker. Attendance 39. Attendance ratio 0.45.

• *GOLDEN GATE*: Introduced by D. E. McLeod, P. T. Olafson showed a moving picture and conducted a discussion on perimeter heating at the January meeting.

Plans for Engineers Week were discussed by K. F. Baldwin, Jr., and S. W. Terry, general chairman of Committee on Arrangements, reported on the progress on the Semi-Annual Meeting to be held in San Francisco, June 27-29. Attendance 96.

• *INDIANA*: Dehumidification was the topic of discussion at the January meeting. J. M. Teskoski, program chairman, intro-

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

duced D. M. Valentine, district manager, Kathabar Division, Surface Combustion Corp., Park Ridge, Ill., who discussed chemical dehumidification, and O. W. Morgan, Worthington Corp., Harrison, N. J., who covered mechanical dehumidification.

R. C. Blackman, member, Chapters Conference Committee, reported on the deliberations of that committee concerning redistricting and a change in the By-Laws.

• *INLAND EMPIRE*: In the absence of L. J. Sandhofer, in January, J. R. Morris read a report on *Noise Control in Industry*. At the close of the report, Richard Saldin and L. D. Daniels answered questions and led a discussion on the decibel system and noise level.

Following the close of the regular meeting, a special meeting was called to allow thorough discussion of the redistricting of regional areas. Attendance 24.

• *KANSAS CITY*: At the joint *ASRE*-ASHAE January meeting, G. H. Neptune, chairman of *ASRE* and ASHAE member, presided and introduced the officers of both societies.

J. C. Robbins, *ASRE* program chairman who also holds ASHAE membership, introduced the speaker, P. A. McLeod, manager, Centrifugal Refrigeration Section, Air Conditioning and Refrigeration Division, Worthington Corp., Harrison, N. J. Mr. McLeod pointed out the desired principles of *Centrifugal Refrigeration Compressors*, using a series of slides showing cutaway construction. Attendance 103. Attendance ratio 0.28.

• *MANITOBA*: *Metropolitan Development in Greater Winnipeg* was the subject of a talk by E. Thrift, Metropolitan Planning Commission, at the January meeting. D. S. Swain introduced Mr. Thrift.

Pres. G. T. Christie, A. J. McIntyre and J. A. Bell will act as delegates to the meeting of Canadian chapters to be held in Toronto. Attendance 16.

• *MICHIGAN*: Discussing the geological foundation of the Detroit area, C. G. Merriman, civil engineer, Detroit Edison Co., Detroit, Mich. spoke in January on *Foundations*. Mr. Merriman covered the history and development of types of foundations, particularly for powerhouses, and mentioned some of the problems encountered when excavating in Detroit clay for plant building. Attendance 230. Attendance ratio 0.63.

• *MINNESOTA*: At a joint *ASRE*-ASHAE meeting in January, ASHAE Pres. J. E. Haines introduced the speaker, Dean Spilhaus, who devoted his talk to *Elements of Total Environment Control*.

J. A. Craig, president of the Minnesota Chapter, ASHAE, introduced the officers of both societies, and G. F. Gausman reported on the activity of the membership committee.

• *MISSISSIPPI*: Pres. J. E. Davis, Jr. announced the following appointments of committee chairmen at the January meeting: *Program*—F. H. North; *Membership*—Burt Lomax, Jr.; *Attendance*—L. H. Smith; *Publicity*—N. F. England; *Finance*—J. W. Doggett, Jr.; and *Special Events*—T. D. Luke, Jr. James Dent was elected to the Board of Governors to take the place of I. E. Rowe, who moved out of the state.

M. E. Arledge introduced F. M. Johnson, sales manager, air conditioning, Surface Combustion Corp., Toledo, Ohio, who presented a program on new developments in *Humidity Conditioning*. Attendance 24.

• *NORTH TEXAS*: Committee chairmen for 1955 were introduced in January by Pres. J. A. Ray: *Program*—W. P. Glancy; *Publication*—F. L. Gray, Jr.; *Hospitality*—J. D. Poythress; *Membership*—Fred Manget, Jr.; *Attendance*—H. V. Alexander; *Technical Advisory*—D. C. Pfeiffer; *Publicity*—E. J. Hatzenbuehler; and *By-Laws*—E. T. Gessell.

P. N. Vinther presented a past president's pin to M. W. Brown. Attendance 100. Attendance ratio 0.43.

• *OKLAHOMA*: A talk by A. J. Hess, president of Hess-Greiner and Polland, Los Angeles, on the *Refrigeration Side of Air-Conditioning* was given at the joint January meeting of the Oklahoma Chapter of ASHAE and the Central Oklahoma Chapter of the *Oklahoma Society of Professional Engineers*, which was presided over by Society Chapter Pres. G. E. Ervin.

Mr. Hess traced the development of refrigeration and predicted the increasing use of storage-type systems, heat pumps and the greater adoption of centrifugal machines in installations of 50 tons or more. He believed that absorption units will be used in installations where they can operate on waste air, and air cooled units where there is a water shortage. Mr. Hess predicted that in the future new refrigerants will be used for specific purposes. Attendance 105. Attendance ratio 0.41.

• *ONTARIO*: J. L. Jones, D. W. Ferguson Co., was moderator of a panel on *How to Heat a* $30,000 *Home* at the January meeting of this chapter, presided over by Pres. M. C. Bailey. Panel members were: S. L. V. Fisher, manager, Toronto office, Trane Co., Ltd., speaking on *Hot Water Heating;* W. A. Connor, manager, Boxer Sales, John Inglis Co., Ltd., Toronto, whose subject was *Radiant Heating;* F. Thompson, Lennox Furnace Co., speaking on *Forced Warm Air Heating;* and D. B. Thomas, manager, sales, air-conditioning department, Canadian General Electric Co., Toronto, speaking on *Year 'Round Air Conditioning*. Attendance 102.

• *OREGON*: Eight members of the Student Branch at Oregon State College were present at the January meeting, after an annual field trip to firms in the Portland area.

The new chapter members introduced by G. G. Van Alst, chairman of membership committee, were: D. E. Brous, Jr., J. L. Waymire, and in absentia, G. E. Osborn and J. E. Sandberg.

R. L. Schroeder, program chairman, introduced W. O. Stewart, manager, Los Angeles branch, Johnson Service Co. Mr. Stewart's presentation of *Latest Methods of Unit Ventilator Control and Air Volume Control in Double Duct Systems* met with interest and inspired a number of questions. Attendance 80. Attendance ratio 0.42.

• *OTTAWA*: A panel discussion on *Heating, Ventilating and Air Conditioning* was held at the January meeting of the Ottawa Chapter, which was presided over by Pres. W. J. Robinson. G. A. Gray, C. A. Schock and G. L. Ostiguy discussed steam, hot water and warm-air heating, respectively; J. W. Green and N. J. Howes spoke on various types of ventilation; and R. H. Soderlind, Jr., and B. Hardy clarified the distinction between air conditioning and air cooling. Members were stimulated to join in a general discussion on the topics presented. Attendance 25. Attendance ratio 0.46.

• *PITTSBURGH*: L. N. Hunter, Johnstown, Pa., then Society president, attended a January dinner and subsequent meeting of the Pittsburgh Chapter, presided over by Pres. E. C. Hach. President Hunter, in his capacities as President of the Society and as a Pittsburgh chapter member, spoke on the Annual Meeting in Philadelphia.

The speaker of the evening introduced by Program Chairman R. M. Toucey, was C. B. Hershey, supervising heating and ventilating engineer, school plant division, department of public instruction, Commonwealth of Pennsylvania. His subject was the proposed *Revised Heating and Ventilating Regulations for Pennsylvania School Buildings*. Mr. Hershey covered the financial and mechanical details of school cost per pupil, and outlined the many proposed changes to the code. Attendance 126.

• *ROCKY MOUNTAIN*: A motion was carried at the January meeting of the Rocky Mountain chapter to cast a unanimous ballot for the five members nominated to serve on the nominating committee for 1955. Prof. B. H. Spurlock, Jr., Department of Mechanical Engineering, University of Colorado, discussed the Society dues. Pres. V. F. Vallero presided.

The guest speaker was F. A. Rohrman, executive director of the Engineering Experiment Station, University of Colorado, who was introduced by Vice Pres. F. C. Allen. Dr. Rohrman spoke on *Atomic Energy* and simplified his complicated subject so that a clear impression was left on his listeners' minds of the basic differences in nuclear energy and the variety and effectiveness of materials used. He placed the burden of responsibility of effective use of these materials on mechani-

cal engineers. Attendance 47. Attendance ratio 0.34.

• *SACRAMENTO VALLEY*: P. T. Olafson presented an excellent color film at the January meeting, describing and illustrating a system of perimeter heating and ventilating. This system utilizes forced warm air in an underfloor plenum to achieve warm floors and floor or wall registers for air supply to the room. Presiding officer was Pres. J. E. Marshall. Attendance 102. Attendance ratio 0.53.

• *ST. LOUIS*: At the conclusion of the January business meeting, which was presided over by Pres. W. P. Norris, A. W. Felt, chairman of the research committee, addressed the members on the subject of research.

W. J. Brann, sales engineer, Owens-Corning Fiberglas Co., St. Louis, Mo., spoke on *Fibrous Glass Insulation as used in the Heating and Ventilating Profession.* Mr. Brann, the speaker for the evening, was introduced by E. T. Clucas. An outstanding speaker, Mr. Brann described various types of insulating and non-insulating glass fiber material. He was assisted during the question and answer period by William Allen, also of Owens-Corning Fiberglas Co.

B. L. Evans, former Council Member of the Society, was presented with an attendance award of a glass fishing rod. Attendance 53.

• *SHREVEPORT*: The guest speaker at the January meeting of the Shreveport chapter was N. F. England, Metalbestos Division, William Wallace Co., Jackson, Miss. Mr. England spoke on the subject of *Gas Venting* and reviewed the various ways of venting gas-fired equipment. He commented on recent research and new developments which have resulted in better gas venting. Presiding officer was Pres. J. S. Malahy, Jr. Attendance 33. Attendance ratio 0.48.

• *SOUTH CAROLINA*: At the meeting in January, H. L. McDowell introduced the speaker, A. S. Morton, Chesapeake & Ohio Railway Co., whose subject was the *Economical Operation of the Small Steam Boiler Plant.* Mr. Morton discussed recommended types of coal, various coal and ash handling equipment, and proper general maintenance. Attendance 45. Attendance ratio 0.38.

• *SOUTH TEXAS*: Recent trends in school design were presented in January by Stayton Nunn, co-ordinating architect, the Houston Independent School District. With the assistance of slides, Mr. Nunn described in some detail a new school design consisting of a one-story building arranged for maximum utility and ready expansion to meet future requirements. J. N. Powell introduced the speaker.

Vice Pres. F. M. Neil presided at this meeting. Attendance 51.

• *SOUTHERN CALIFORNIA*: R. H. Phillips, sales engineer, Carrier Corp., Los Angeles, addressed the January meeting on *Application of Refrigeration to Air Conditioning.* Mr. Phillips, who was introduced by J. R. Hall, program chairman, gave detailed descriptions, operating characteristics, and cost analysis of types of refrigeration machines, together with their application to air conditioning. A lively question period followed. The meeting was presided over by Pres. C. D. Walz. Attendance 78.

• *SOUTHERN PIEDMONT*: Officers elected at the January meeting were as follows: *President*—L. F. Lawrence, Jr.; *Vice President*—J. A. Rice; *Secretary*—G. C. Garrett; *Treasurer*—G. N. Payne, Jr.; *Board of Governors*—R. S. Fullerton, S. B. Blanton and C. M. Setzer, Jr.

Fundamentals of High Velocity Air Distribution was the title of the talk given by C. M. Wilson, general sales manager, Anemostat Corporation of America, New York, N. Y., who was introduced by D. V. Howard, program chairman. Pres. L. F. Lawrence, Jr. presided. Attendance 42. Attendance ratio 0.31.

• *TOLEDO*: Following a social hour and the January business meeting which was presided over by Pres. F. C. Richardson, the speaker of the evening, W. P. Chapman, engineering sales representative, National Tube Division, U. S. Steel Corp., was introduced by the chairman, F. A. Edgington.

Mr. Chapman's subject was *Snow Melting*, and he covered the theory behind a snow melting design enumerating the variables: rate of snowfall, air temperature, wind velocity, and relative humidity. He also discussed the derivation of the formulas involved, application of the systems and the problem of corrosion. The discussion period brought out several interesting points concerning anti-freeze and thermal stresses. Total attendance 47. Attendance ratio 0.50.

• *UTAH*: Featured at the January meeting was a talk by Harry Watson, Mountain States Telephone & Telegraph Co. Introduced by Vice Pres. R. C. Evans, Mr. Watson spoke on *High Frequency Transmission*, outlining the principles involved in television pickup, transmission and re-screening. The members enjoyed his demonstration of many of the interesting phenomena of transmission.

Secy. W. L. Stuewe expressed the request of Prof. William Barnes, University of Utah, that the Chapter members consider taking part in the Second Annual Intermountain Conference on Air Conditioning, Heating and Ventilating. Attendance 20. Attendance ratio 0.36.

• *WASHINGTON, D. C.*: A number of guests from *AIEE*, *ASME* and *ASRE* were drawn by the topic for the January meeting which had been publicized in the Science Calendar. Vice Pres. W. C. Reamy, Jr., introduced and welcomed the guests.

S. H. Robbins, Jr., program chairman, presented P. R. Achenbach, assistant chief, Heating & Air Conditioning Section, National Bureau of Standards. Speaking on *Panel Heating*, Mr. Achenbach covered tests made on various panel heating systems in the Test Bungalow at the Bureau of Standards, as well as tests and reports on panel heating systems installed throughout the country. Covering all phases of his subject, Mr. Achenbach discussed hot water, warm air, and electrical panel heating, and the use of reflective materials on walls, under floors, and on or over ceilings. His talk was very well received, and was followed by a long informal question and answer period. Attendance 65. Attendance ratio 0.37.

• *WEST TEXAS*: Temperature controls was the subject of the January presentation. Four speakers from the Lubbock, Tex. area participated, with R. A. Mixon acting as moderator. V. B. Garry devoted his talk to residential applications of temperature controls; C. J. Selesky discussed the function of various types of motor-operated temperature control dampers, and H. L. Mayes finished with applications of chilled and hot water control valves.

Following this program, Pres. L. C. McKay installed the newly elected officers: *President*—R. B. Carow; *Vice President*—J. C. Wharton; *Secretary*—H. L. Mayes; *Treasurer*—D. G. Halley; *Board of Governors*—L. C. McKay, R. L. Mason and G. T. Keyton. The new president appointed the following committee chairmen: *Membership*—R. A. Mixon; *Program*—V. B. Garry; *Publications*—J. G. Samson and *Code Advisory*—M. J. Aderton, chairman, and C. P. Houston, co-chairman. Attendance 19. Attendance ratio 0.31.

• *WESTERN MICHIGAN*: A talk on *Hot Water Heating* was given by H. A. Lockhart, vice president, Bell & Gossett Co., Morton Grove, Ill., following the January business meeting at which Pres. F. W. Brundage presided. Mr. Lockhart, who was introduced by B. J. Walter, made brief mention of the various uses of hot water heating. He then turned to a more technical discussion of expansion tanks, especially recommending the choice of a tank slightly too small rather than one that was too large, if there had to be a choice between the two. Mr. Lockhart answered a barrage of questions and stayed to answer more after the meeting. The program chairman for this meeting was R. B. Smith.

STUDENT BRANCH

• *UNIVERSITY OF TORONTO*: F. G. Ewens, assistant professor of mechanical engineering, University of Toronto, told the members in December of some cases in which is was necessary to apply psychology to air conditioning.

Election of officers resulted in the following: *President*—W. A. Stewart, and *Secretary*—R. M. Davies. Attendance 10. Attendance ratio 0.83.

Candidates for Membership

Journal Section

The Society's By-Laws require that all applications for membership or advancement are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society, or mailed to all members. When the replies are received from references the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall confirm the election of the proposed Candidate for membership. During the past month there have been 119 applications for membership, including 17 student applications and 3 reinstatements; in addition 5 advancements have been received. The names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by April 30, 1955, these candidates will be voted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

Note: †Reinstatement. *Non-member. △Advancement.

Arizona

ROBINSON, P. E., Estimator, Valley Sheet Metal Co., Phoenix. REFERENCES: R. L. Bayless, Jr., W. A. Biddle, B. A. Russell, G. C. Webster.

California

DADSON, F. W., Western Mgr., General Controls Co., Glendale. REFERENCES: R. M. Johnson, L. B. Rayl, G. C. Schultze*, K. E. Wilson*.

RIGGLE, N. A., Engr., Thomas H. Parry, Cons. Mech. Engr., Pasadena. REFERENCES: J. R. Hall, Culver Heaton*, T. H. Parry, R. C. Taylor.

WHITTELL, ALFRED, JR., Pres., Raypak Co., Inc., El Monte. REFERENCES: W. G. Craig*, A. J. Horn, C. H. Laws*, T. H. Parry.

Colorado

FINNIE, M. W., Owner, Conaway Furnace Co., Inc., Denver. REFERENCES: William Eagan*, Fred Janssen, J. F. LaTorra, B. H. Spurlock.

HOWARD, E. E., Engr., American Blower Corp., Denver. REFERENCES: A. W. Cooper, J. J. Johnson, J. H. McCabe, H. L. Wray.

RICHARDSON, R. A., JR., Mech. Sales Engr., McCombs Supply Co., Denver. REFERENCES: G. C. Andresen, J. V. Berger, J. F. Cipra, Jr., V. L. Wilken*.

VAN WYK, R. J., Estimator, William Van Genderen Co., Denver. REFERENCES: F. L. Adams, William Van Genderen, R. L. Whittlesey, A. S. Widdowfield.

Connecticut

DUBIN, F. S., Owner, Fred S. Dubin Associates, Hartford. REFERENCES: H. B. Agard, R. B. Cahoon, S. D. Henderson, E. J. Hoagland.

LEMMERMAN, R. D., In charge of Engrg. and Research Dvlpt., Industrial Sound Control, Inc., Hartford. REFERENCES: Daniel Callaway*, Howard Hardy*, Harold Lockwood*, A. A. Maycock.

Delaware

MCKEE, J. C., Service Engr., E. I. duPont de Nemours & Co., Wilmington. REFERENCES: L. M. Church, C. W. Coward, S. F. Des Marais, V. H. Hill.

Florida

FONDERSMITH, E. M., Mfrs. Agent, St. Petersburg. REFERENCES: L. M. Becknell*, C. L. Hewitt, Jr.*, G. J. Kollock*, F. J. Nunlist, Jr.

Illinois

HEGBERG, R. A., Field Engr., The Powers Regulator Co., Skokie. REFERENCES: C. A. Gustafson, P. B. Hultgren, A. J. Keating, K. M. Stevens.

MAXIM, W. S., Chief Mech. Engr., Abbott Laboratories, North Chicago. REFERENCES: A. T. Jorn, J. S. Kearney, P. J. Marschall, G. V. Zintel.

OATS, F. B., Dist. Engr., Air Cond. Div., Surface Combustion Corp., Park Ridge. REFERENCES: Sidney Fenstermaker, Jr., E. W. Gifford, G. V. Sutfin, G. V. Zintel.

WHITE, R. C., Sales Engr., Carrier Corp., Chicago. REFERENCES: W. S. Bodinus, C. W. Deland, Herbert Kreisman, H. J. Lauterbach.

Indiana

JOHNSON, H. F., Project Engr., Eli Lilly & Co., Indianapolis. REFERENCES: J. H. Bailey*, F. E. Phelps, G. B. Supple, G. W. Vogel.

REAM, W. C., Vice Pres., Sink & Edwards, Indianapolis. REFERENCES: W. W. Grear, P. O. Patterson, G. B. Supple, G. W. Vogel.

Kansas

SNYDER, R. R., Sales Engr., General Air Conditioning and Electrical Co., Salina. REFERENCES: Ralph Barnard*, E. F. Cassing, Leroy Sanderson*, John Zimmerman*.

Kentucky

KIMBALL, L. C., Asst. Chief Engr., Gas Dept., American Radiator & Standard Sanitary Corp., Louisville. REFERENCES: R. B. Duggan, F. E. Hanson, L. L. Smith, J. B. Uhl.

Louisiana

AUSTIN, C. W., Sales Repr., Jim Austin Motor Co., Inc., Baton Rouge. REFERENCES: E. S. Adler, Jr.*, F. T. Carroll*, G. F. Matthes*, H. J. Weilbacher.

CHAPPUIS, A. C., JR., Sales Engr., Bryner-Spranley, Inc., Rayne. REFERENCES: J. J. Bryner, C. M. Hadra, E. E. Spranley, C. S. Woodruff.

FACUNDUS, B. A., Owner, Williams Sheet Metal Shop, Baton Rouge. REFERENCES: A. J. Mayers, Jr., T. G. Neff, W. I. Pol, H. J. Weilbacher.

FILARDO, VICTOR, Secy. & Treas., Paramount Sheet Metal Works, Inc., Baton Rouge. REFERENCES: G. S. Cox, W. J. Speakman, F. W. Stone, C. S. Woodruff.

FOGGIN, R. M., Vice Pres., McCallum Plumbing Co., Inc., Baton Rouge. REFERENCES: Walter Cooke, W. C. Murphy, Theodore Offner, J. L. Rabun.

HOGG, C. W., JR., Engr. & Partner, J. F. Naylor & Co., Baton Rouge. REFERENCES: A. J. Mayers, Jr., J. F. Naylor, B. M. Payne, C. S. Woodruff.

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Netherlands

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Journal Section

OBITUARIES

DAVID S. JACOBUS, EMINENT ENGINEER, DIES AT 93

David Schenck Jacobus, 93, prominent authority on steam engineering, died at his home in Montclair, N. J. on February 12, 1955.

During his long and active career, Dr. Jacobus was the author of numerous papers, and conducted extensive research, including experiments and tests on acetylene gas generators, fire sprinkler systems, refrigerating machines and steam engines. He held 188 patents on boilers, furnaces, super-heaters and other power plant equipment.

Born in Ridgefield, N. J. on January 20, 1862, Dr. Jacobus was graduated from Stevens Institute of Technology in 1884, receiving his M. E. After graduation, he became an instructor at the Institute, and later assistant professor. In 1897, he was elevated to professor of experimental mechanics and engineering physics. During the later years in this capacity, he also was in charge of the Carnegie Laboratory of Engineering.

Stevens Institute gave him the honorary degree, Dr. Eng., in 1906.

D. S. Jacobus

In that year he joined Babcock and Wilcox Co., New York, N. Y. as an advisory engineer, remaining with the company until his retirement in 1941.

Dr. Jacobus was widely honored. He was awarded the Morehead Medal

for 1935 by the *International Acetylene Association* for leadership in formulating codes and procedures, the Miller Medal of the *American Welding Society* in 1943, and was selected National Modern Pioneer by the *National Association of Manufacturers* in 1940. He had the distinction of having a building named after him during his lifetime, Jacobus Hall at Stevens Institute of Technology, where Dr. Jacobus was a life member of the Board of Trustees. A past president of *ASRE*, the *American Welding Society*, and *ASME*, he served for many years as chairman of the *ASME* Boiler Code Committee. He was also chairman of the 1938 and 1942 editions of the *American Welding Society Welding Handbook*.

Joining ASHAE in 1916, Dr. Jacobus was particularly interested in the Society's research activities, and he served as a coordinator in boiler code work with *ASME*. In 1932, he was honored by Life Membership.

A fellow in the *American Association for the Advancement of Science*, Dr. Jacobus also held membership in the *American Institute of Mining and Metallurgical Engineers, American Society of Naval Architects and Marine Engineers, AIEE, American Society for Metals, ASTM, Society for the Promotion of Engineering Education* and *American Petroleum Institute*. Among still others, he enjoyed membership in the *American Mathematical Society, Newcomen Society* and *Franklin Institute*.

Surviving are a son, Dr. David D. Jacobus; a daughter, Mrs. Fred A. Muschenheim, and two brothers, Martin R. and Robert F. Jacobus.

RAY L. GIBBONEY
Toledo, Ohio

Ray L. Gibboney, owner, Gibboney Plumbing & Heating Co., Toledo, Ohio, died recently.

Born in Tiffin, Ohio, on December 16, 1890, Mr. Gibboney attended school in Toledo. In 1914, he became affiliated with Wm. G. Coyle Co., which was later known as Gibboney Plumbing & Heating Co. He assumed ownership of the business in 1941, working at estimating and construction, as well as management. Mr. Gibboney had not long been a member of the Society at the time of his death.

SILAS M. TRUMBO
Chicago, Ill.

The Society learned of the recent death of S. M. Trumbo, Buffalo Forge Co., Chicago, Ill.

Mr. Trumbo, who died at 63, was born on July 23, 1891 at St. Mary's, Kans. He received a B. S. in architectural engineering from the University of Illinois in 1916. Upon graduation, he joined the Buffalo Forge Co. as a sales engineer and remained in that connection until his death, except for a brief period from 1917-18 with the U. S. Army Engineers Corps. Mr. Trumbo had been a member of the Society since 1926.

EUGENE A. VIVARTTAS
New York, N. Y.

Eugene A. Vivarttas, a Life Member of the Society, died recently in his 87th year, passing away peacefully in his sleep.

Mr. Vivarttas was born in Baltimore, Md. on June 17, 1868. He served an apprenticeship with John Reed, machinist, New York, N. Y. from 1885-87, and gained drafting experience with Aloha Vivarttas, architect and engineer. In later years, he worked with Warren & Wetmore, and Jardine, Murdock & Wright, both of New York, N. Y., as well as other architectural firms, designing heating and ventilating equipment for hotels, residences, hospitals, churches, schools, department stores and office buildings.

A member of the Society since 1910, Mr. Vivarttas became a Life Member in 1938.

A daughter, Mrs. Henry A. Gerken, survives.

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ASHAE — OFFICERS OF CHAPTERS AND BRANCHES

(59 Chapters; 1 Special Branch; 8 Student Branches)

Date indicates year organized; an address and no city shown signifies same city as headquarters; numeral in parentheses indicates zone.

● **ARIZONA:** 1953. Hdqrs., Phoenix. Meets, 1st Mon. PRES., W. A. Bidd'e, 3817 N. 15th Ave. SECY., E. P. Maxwell, 39 W. Adams St.

● **ARKANSAS:** 1952. Hdqrs., Little Rock, Ark. Meets, 3rd Tues. PRES., W. J. Franklin, 608 W. Third St. SECY., J. W. Thompson, 1314 Main St.

● **ATLANTA:** 1937. Hdqrs., Atlanta, Ga. Meets, 2nd Mon. PRES., J. M. Lazenby, 8 11th St., N.E. SECY., F. W. Bull, 1205 Spring St., N.W.

● **BALTIMORE:** 1949. Hdqrs., Baltimore, Md. Meets, 3rd Wed. PRES., E. H. Taze, 33 E. 21st St. (18). SECY., R. F. Weisman, 4650 Reisterstown Rd. (15).

● **BLUEGRASS:** 1954. Hdqrs., Louisville, Ky. Meets, 2nd Mon. PRES., J. W. May, 215 Central Ave. SECY., A. E. Hausmann, 227 Lowell Ave., Charlestown, Ind.

● **BRITISH COLUMBIA:** 1952. Hdqrs., Vancouver, B.C., Canada. Meets, 2nd Wed. PRES., S. C. Gale, 1628 W. 4th Ave. SECY., D. A. English, 1606 W. 1st Ave. (9).

● **CENTRAL NEW YORK:** 1944. Hdqrs., Syracuse, N. Y. Meets, 4th Wed. PRES., F. D. Putnam, 115 Pulsifer Dr., Auburn. SECY., Merle Weninger, 230 Goodrich Ave. (5).

● **CENTRAL OHIO:** 1944. Hdqrs., Columbus, Ohio. Meets, 3rd Mon. PRES., J. A. Guy, 478 W. Fifth Ave. (1). SECY., W. A. Schoonover, 2901 N. High St. (2).

● **CINCINNATI:** 1932. Hdqrs., Cincinnati, Ohio. Meets 1st Tues. PRES., F. W. Wilson, 222-24 E. 14th St. SECY., R. G. Anderson, 1758 Elmore St. (23).

● **CONNECTICUT:** 1940. Hdqrs., New Haven, Conn. Meets, 3rd Thurs. PRES., C. L. L'Hommedieu, 76 Blatchley Ave. SECY., Walter Heywood, 1007 Farmington Ave., West Hartford.

● **DELTA:** 1939. Hdqrs., New Orleans, La. Meets, 3rd Tues. PRES., C. V. Bankston, 2927 Jackson Ave. (25). SECY., W. B. Martin, Jr., 635 Commercial Place.

● **EMPIRE STATE CAPITAL:** 1951. Hdqrs., Albany, N. Y. Meets, 2nd Wed. PRES., E. C. Doyle, 315 Washington Ave. SECY., H. F. Kruger, 501 7th Ave., Troy.

● **GOLDEN GATE:** 1937. Hdqrs., San Francisco, Calif. Meets, 1st Thurs. PRES., Eric Roberts, 417 Market St. SECY., F. K. Crouch, 906 Cerrito St., Albany (6).

● **ILLINOIS:** 1906. Hdqrs., Chicago, Ill. Meets, 2nd Mon. PRES., G. V. Zantel, 840 N. Michigan Ave. (11). SECY., H. G. Gragg, 228 N. LaSalle St. (1).

● **INDIANA:** 1943. Hdqrs., Indianapolis, Ind. Meets, 4th Tues. PRES., P. O. Patterson, 6300 N. Oakland Ave. (20). SECY., A. O. Roche, Jr., 3950 Broadway (5).

● **INLAND EMPIRE:** 1950. Hdqrs., Spokane, Wash. Meets, 1st Mon. PRES., H. A. Bickel, E. 7 Riverside Ave. SECY., Max Tonn, S. 4021 Latawah St.

● **IOWA:** 1940. Hdqrs., Des Moines, Ia. Meets, 2nd Tues. PRES., W. E. Nanes, 220 Davidson, Bldg. SECY., D. E. Schroeder, 2717 Cambridge.

● **KANSAS:** 1951. Hdqrs., Wichita, Kan. Meets, Tues. after 1st Mon. PRES., Charles Yoe, P.O. Box 2239. SECY., T. L. Roberts, 2008 S. Parkwood Lane.

● **KANSAS CITY:** 1917. Hdqrs., Kansas City, Mo. Meets, 1st Mon. PRES., F. K. Ladewig, 3527 Broadway (11). SECY., R. M. Spencer, 1510 Main St. (8).

● **MANITOBA:** 1935. Hdqrs., Winnipeg, Man., Canada. Meets, 4th Thurs. PRES., G. T. Christie, Midland & Notre Dame. SECY., A. J. McIntyre, 935 Garwood Ave.

● **MASSACHUSETTS:** 1912. Hdqrs., Boston Mass. Meets, 3rd Tues. PRES., G. W. Sprague, 108 Cummington St. SECY., W. G. Burbo, 137 Newbury St. (16).

● **MEMPHIS:** 1944. Hdqrs., Memphis, Tenn. Meets, 3rd Mon. PRES., A. W. Shelby, 972 Union Ave. SECY., A. T. Bevil, 1638 Union Ave. (4).

● **MIAMI VALLEY:** 1950. Hdqrs., Dayton, Ohio. Meets, 1st Wed. PRES., R. W. Kimmel, 320 Loneworth St. (2). SECY., J. B. Rashel, 656 Selma Rd. (9).

● **MICHIGAN:** 1916. Hdqrs., Detroit, Mich. Meets, 1st Mon. after 10th of month. PRES., E. F. Glanz, 1761 W. Forest Ave. (8). SECY., J. H. Spitzley, 1200 Fort St., W. (26).

● **MINNESOTA:** 1918. Hdqrs., Minneapolis, Minn. Meets, 1st Mon. PRES., J. A. Craig, 814 S. Ninth St. (4). SECY., E. T. Erickson, 500 Baker Arcade (2).

● **MISSISSIPPI:** 1953. Hdqrs., Jackson, Miss. PRES., J. E. Davis, Jr., P.O. Box 3216, West Jackson (7). SECY., L. H. Smith, 711 W. Capitol St.

● **MONTREAL:** 1936. Hdqrs., Montreal, Que., Canada. Meets, 3rd Mon. PRES., D. L. Lindsay, 4350 Sherbrooke St. (6). SECY., S. R. Piamondon, 2267 Melrose Ave. (14).

● **NEBRASKA:** 1940. Hdqrs., Omaha, Neb. Meets, 2nd Tues. PRES., C. A. Goth, 3115 N. 49th Ave. SECY., L. J. Paulsen, 1901 S. 39th St.

● **NEW MEXICO:** 1954. Hdqrs., Albuquerque, N. M. PRES., J. H. Van Alsburg, 1330 Cerro Gordo, Santa Fe. SECY., J. K. James, 4462 Avenida del Sol.

● **NEW YORK:** 1911. Hdqrs., New York, N. Y. Meets, 3rd Mon. PRES., R. L. Stinard, 51 E. 42nd St. (17). SECY., Carl H. Flink, 62 Worth St. (13).

● **NORTH JERSEY:** 1952. Hdqrs., Newark, N. J. Meets, 2nd Tues. PRES., H. M. Patrick, 20 Olcott Ave., Bernardsville. SECY., W. C. Kruse, Jr., 183 N. 13th St. (7).

● **NORTH TEXAS:** 1938. Hdqrs., Dallas, Tex. Meets, 3rd Mon. PRES., J. A. Ray, 4411 Belmont Ave. (4). SECY., G. H. Meffert, 3328 Greenbrier Dr. (5).

● **NORTHEASTERN OKLAHOMA:** 1948. Hdqrs., Tulsa, Okla. Meets, 2nd Tues. PRES., J. T. McKinney, P.O. Box 5145 (16). SECY., G. A. McCune, 1908 Utica Square.

● **NORTHERN OHIO:** 1916. Hdqrs., Cleveland, Ohio. Meets, 2nd Mon. PRES., D. E. Mannen, 9104 Woodland Ave. (3). SECY., H. R. Canoyer, 1900 Superior Ave. (14).

● **NORTHERN PIEDMONT:** 1952. Hdqrs., Greensboro, N. C. Meets, 2nd or 3rd Fri. PRES., S. T. Oliver, 2307 Fairfield Ave. SECY., E. D. Frazier, 320 Ashland Dr.

● **OKLAHOMA:** 1925. Hdqrs., Oklahoma City, Okla. Meets, 2nd Mon. PRES., G. E. Ervin, 2800 N. Oklahoma St. (5). SECY., F. R. Denham, 320 Oklahoma Natural Bldg.

● **ONTARIO:** 1922. Hdqrs., Toronto, Ont., Canada. Meets, 1st Mon. PRES., M. C. Bailey, 1139 Bay St. SECY., H. R. Roth, 57 Bloor St., W.

● **OREGON:** 1939. Hdqrs., Portland, Ore. Meets, Thurs. after 1st Tues. PRES., Dick Blankenship, Cascade Bldg. (4). SECY., W. B. Hayes, 6446 NE 24th (11).

● **OTTAWA VALLEY:** 1952. Hdqrs., Ottawa, Ont., Canada. Meets, 3rd Tues. PRES., W. J. Robinson, 200½ Bank St. SECY., N. J. Howes, Box 264, R.R. 1.

● **PACIFIC NORTHWEST:** 1928. Hdqrs., Seattle, Wash. Meets, 2nd Tues. PRES., T. C. Carkey, 11642—26th Ave., S. (88). SECY., E. W. Triol, 407 Medical Arts Bldg. (1).

● **PHILADELPHIA:** 1916. Hdqrs., Philadelphia, Pa. Meets, 2nd Thurs. PRES., L. M. Church, 12 S. 12th St. (7). SECY., C. J. Forve, Parkwood Manor, Apt. B-202, State Rd. & Penarth Ave., Upper Darby.

● **PITTSBURGH:** 1919. Hdqrs., Pittsburgh, Pa. Meets, 3rd Mon. PRES., E. C. Hach, 221 Broadmoor Ave. (34). SECY., E. H. Riesmeyer, Jr., 231-33 Water St. (22).

● **ROCKY MOUNTAIN:** 1944. Hdqrs., Denver, Colo. Meets, 1st Wed. PRES., V. F. Vallero, 620 12th St. SECY., D. D. Pearsall, 520 Acoma St. (4).

● **SACRAMENTO VALLEY:** 1952. Hdqrs., Sacramento, Calif. Meets, 1st Wed. PRES., J. E. Marshall, 441 Pico Way. SECY., V. W. Thornburg, 2470 27th Ave.

● **ST. LOUIS:** 1918. Hdqrs., St. Louis, Mo. Meets, 2nd Tues. PRES., G. H. Bemarkt, St. Clair Dr., R.R. 1, Caseyville, Ill. SECY., W. P. Norris, 1118 Fullerton Bldg.

● **SHREVEPORT:** 1948. Hdqrs., Shreveport, La. Meets, 3rd Thurs. PRES., J. S. Malahy, Jr., 1839 Line Ave. SECY., H. E. Scott, 2502 Woodford St.

● **SOUTH CAROLINA:** 1954. Hdqrs., Columbia, S. C. PRES., R. F. Donovan, P.O. Box 3053. SECY., J. E. McMurray, 1639 Blanding St.

● **SOUTH TEXAS:** 1938. Hdqrs., Houston, Tex. Meets, 3rd Fri. PRES., J. W. Holland, 245 Esperson Bldg. (2). SECY., J. C. Lewis, Box 8188.

● **SOUTHERN CALIFORNIA:** 1930. Hdqrs., Los Angeles, Calif. Meets, 1st Tues. PRES., C. D. Walz, 3600 San Pasqual St., Pasadena (10). SECY., H. F. Ulovec, 3886 Olympiad Dr. (43).

● **SOUTHERN PIEDMONT:** 1952. Hdqrs., Charlotte, N.C. PRES., L. F. Lawrence, Jr., 212 Greystone Rd. SECY., G. C. Garrett, P.O. Box 3697.

● **SOUTHWEST TEXAS:** 1946. Hdqrs., San Antonio, Tex. Meets, 3rd Tues. PRES., L. H. Hornor, Jr., 816 Insurance Bldg. SECY., Boone Crisp, P.O. Box 9065 (4).

● **TOLEDO:** 1954. Hdqrs., Toledo, Ohio. PRES., F. C. Richardson, Jr., 1928 Shenandoah Rd. (7) SECY., J. F. Guest, 1815 N. 13th St. (2).

● **UTAH:** 1944. Hdqrs., Salt Lake City, Utah. Meets, 3rd Thurs. PRES., A. A. Maycock, P.O. Box 36 (10). SECY., W. L. Stuewe, 1472 S. State St. (4).

● **VIRGINIA:** 1946. Hdqrs., Norfolk, Va. Meets, 3rd Wed. PRES., T. B. Carpenter, 8400 Millard St. SECY., C. G. Conaway, Jr., 4701 Colley Ave.

● **WASHINGTON, D. C.:** 1935. Hdqrs., Washington, D. C. Meets, 2nd Wed. PRES., W. C. Reamy, Jr., 720 Mills Bldg. (6). SECY., S. H. Robbins, Jr., 2009 K St., N.W.

● **WEST TEXAS:** 1953. Hdqrs., Lubbock, Tex. PRES., R. B. Carow, P.O. Box 3206. SECY., H. L. Mayes, P.O. Box 151.

● **WESTERN MICHIGAN:** 1931. Hdqrs., Grand Rapids, Mich. Meets, 2nd Mon. PRES., F. W. Brundage, 512 N. Park St., Kalamazoo (11). SECY., F. L. Murray, 482 W. Michigan Ave., Battle Creek.

● **WESTERN NEW YORK:** 1919. Hdqrs., Buffalo, N. Y. Meets, 2nd Mon. PRES., O. P. Thompson, 260 Richmond Ave. (22). SECY., G. E. Kuhn, 475 Woodland Dr., Kenmore (23).

● **WISCONSIN:** 1922. Hdqrs., Milwaukee, Wis. Meets, 3rd Mon. PRES., L. C. Plaehn, 914 N. Broadway (2). SECY., H. W. Alyea, 507 E. Michigan St. (2).

SPECIAL BRANCH

● **SWITZERLAND:** 1952. Hdqrs., Zurich. PRES., H. C. Bechtler, Anemonenstrasse 40 (47). SECY., Walter Hausler, Erbstrasse 2, Kusnacht.

STUDENT BRANCHES

● **NORTH CAROLINA STATE COLLEGE:** 1948. Hdqrs., Raleigh, N. C. PRES., Alvah Enrman, Box 4502, State College Station. SECY., R. W. McDonald, 1010½ Vance St.

● **OKLAHOMA A. & M. COLLEGE:** 1950. Hdqrs., Stillwater, Okla. PRES., C. E. Durrett, 1215 College. SECY., R. M. Jauch, 308½ W. Maple.

● **OREGON STATE COLLEGE:** 1949. Hdqrs., Corvallis, Ore. Meets, 1st Wed. after 1st Tues. PRES., R. E. Bulletset, 252 Kings Rd. SECY., I. P. Parkhurst, 1354 Harrison.

● **PURDUE UNIVERSITY:** 1948. Hdqrs., W. Lafayette, Ind. PRES., D. B. Doucette, Purdue Student Branch, ASHAE, School of Mech. Engrg. SECY., J. W. Deabler, Purdue Student Branch, ASHAE, School of Mech. Engrg.

● **TEXAS A. & M. COLLEGE:** 1948. Hdqrs., College Station, Tex. Meets, 2nd and 4th Tues. PRES., D. F. Carroll, Box 6264. SECY., C. W. Farrar, Jr., Rt. 1, Box 339, Bryan.

● **UNIVERSITY OF DETROIT:** 1949. Hdqrs., Detroit, Mich. Meets, 1st Tues. PRES., J. C. Rumpf, 16511 Muirland (21). SECY., L. J. Hayes, Jr., University of Detroit.

● **UNIVERSITY OF TEXAS:** 1949. Hdqrs., Austin, Tex. Meets, 1st and 3rd Tues.

● **UNIVERSITY OF TORONTO:** 1951. Hdqrs., Toronto, Ont., Canada. PRES., W. A. Stewart, 86 Roxborough St., W. (5). SECY., R. M. Davies, 144 Manor Rd., E.

MEETINGS & CONVENTIONS

APR. 13—*Bituminous Coal Research, Inc.*, annual meeting. William Penn Hotel, Pittsburgh. A sales conference will be held on the preceding day. BCR is at 2609 First National Bank Bldg., Pittsburgh 22.

APR. 14-16—*American Society of Heating and Air-Conditioning Engineers, Inc.*, regional meeting. Skirvin Hotel, Oklahoma City. ASHAE headquarters, 62 Worth St., New York 13.

APR. 16—*American Society of Mechanical Engineers*, Organization Anniversary Meeting. Stevens Institute of Technology, Hoboken, N. J. and New York City. Succeeding scheduled meetings are the Diamond Jubilee Spring Meeting, April 18-22, Baltimore; Diamond Jubilee Semiannual Meeting, June 19-23, Boston; Diamond Jubilee Annual Meeting, November 13-18, Chicago. Attendance at some sessions will be limited to invitation only. ASME headquarters, 29 W. 39th St., New York.

APR. 18-20—*3rd National Air Pollution Symposium.* Huntington-Sheraton Hotel, Pasadena, Calif. Headquarters: Stanford Research Institute, 727 W. 7th St., Los Angeles.

APR. 18-21—*National Warm Air Heating and Air Conditioning Association*, short course on the latest trends in the warm air heating industry. Iowa State College, Ames. Chairman: Bruce McLouth, NWAHACA, 145 Public Sq., Cleveland 14.

APR. 19-21—*Oil-Heat Institute of America*, 33rd annual convention. Conrad Hilton Hotel, Chicago. OHI headquarters, 500 Fifth Ave., New York 36.

APR. 25-28—*American Industrial Hygiene Association*, 1955 industrial health conference. Buffalo. The institute is at 4400 Fifth Ave., Pittsburgh 13.

APR. 27-30—*Sheet Metal Contractors' National Association*, annual convention. Mark Hopkins Hotel, San Francisco. J. D. Wilder, executive secretary, 170 Division St., Elgin, Ill.

MAY 10-13—*Heating, Piping and Air Conditioning Contractors National Association*, 66th annual meeting. Shamrock Hotel, Houston. HPACCNA, 30 Rockefeller Plaza, New York 20.

MAY 12-14—*New York State Society of Professional Engineers*, 29th annual convention. Hotel Commodore, New York City. The society is at 1941 Grand Central Terminal, New York 17.

MAY 12-14—*Automation—Engineering for Tomorrow.* An engineering symposium presented as part of the Centennial celebration of Michigan State College. East Lansing.

MAY 22-26—*Air Pollution Control Association*, 48th annual meeting. Detroit. Executive secretary: Harry C. Ballman, APCA, 4400 Fifth Ave., Pittsburgh 13.

MAY 23-25—*Hot Water Steam Heating and Air Conditioning Short Course.* Purdue University. The course will be sponsored by The Institute of Boiler and Radiator Manufacturers. For information, write: Merle M. McClure, assistant director, Division of Adult Education, Purdue Univ., West Lafayette, Ind.

MAY 23-26—*National District Heating Association*, 46th annual meeting. Edgewater Beach Hotel, Chicago. John F. Collins, Jr., secretary-treasurer, NDHA, 827 N. Euclid Ave., Pittsburgh.

JUNE 8-10—*American Welding Society*, 3rd annual show. Municipal Auditorium, Kansas City, Mo. The annual spring technical meeting is to run concurrently with the show, June 7-10. National secretary: Joseph G. Magrath, at the society, 33 W. 39th St., New York 18.

JUNE 12-15—*American Society of Refrigerating Engineers*, semiannual meeting. Milwaukee. ASRE headquarters, 40 W. 40th St., New York 18.

JUNE 26-*JULY* 1—*American Society for Testing Materials.* Chalfonte-Haddon Hall, Atlantic City. The society is at 1916 Race St., Philadelphia 3.

JUNE 27-29—*American Society of Heating and Air-Conditioning Engineers, Inc.*, semiannual meeting. St. Francis Hotel, San Francisco, ASHAE headquarters, 62 Worth St., New York 13.

NOV. 14-18—*Chicago Exposition of Power & Mechanical Engineering.* Coliseum, Chicago. The exposition is being held in conjunction with the 75th Anniversary Meeting of the American Society of Mechanical Engineers. Management: International Exposition Co., Inc., 480 Lexington Ave., New York 17.

NOV. 28-*DEC.* 1—*9th Exposition of the Air Conditioning and Refrigeration Industry.* Convention Hall, Atlantic City. The exposition is sponsored by the Air Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington, D. C.

WHO'S WHAT . . .

new personnel, promotions . . . . .

▸ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—Jerome F. Cummiskey, market development manager for the commercial division; Charles Sanders, in charge of a new electronics sales section in the division. Eldon E. Fox, formerly advertising manager, has been appointed director of advertising and sales promotion for the company.

▸ *GRINNELL CO., INC.*—E. M. Pease, manager of the company's industrial piping division.

▸ *DEBOTHEZAT FANS DIV., AMERICAN MACHINE AND METALS, INC.*—A. M. Harp, general sales manager.

▸ *COOLING TOWER INSTITUTE*—Neal B. LauBach, reelected president. Mr. LauBach is manager of the cooling equipment department of Hudson Engineering Corp. Other officers elected for 1955 terms are Paul R. Hoffmann of Lilie-Hoffmann Cooling Towers, vice president; Clayton E. Pickup of The Fluor Corp., secretary; Sidney Levine of Santa Fe Tank & Tower Co., treasurer.

▸ *B-I-F INDUSTRIES, INC.*—R. W. Pearce, works manager. This position has been vacant since February, 1953, when Earl H. Bradley vacated the post when elected president of the company.

▸ *VULCAN RADIATOR CO.*—M. L. Lundgren, director of sales and advertising.

▸ *WEIL-McLAIN CO.*—Charles A. Wolff, advertising manager.

▸ *NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS*—Solon F. Friedeberg, a national director. Mr. Friedeberg is an associate of Sears and Kopf, mechanical and electrical consulting engineers in New York City.

▸ *WORTHINGTON CORP.*—Andrew F. Ward, sales manager for packaged products in the corporation's Air Conditioning and Refrigeration Div.

▸ *COAL PRODUCERS COMMITTEE FOR SMOKE ABATEMENT*—Harry G. Kennedy, chairman of the executive committee. Mr. Kennedy is secretary of the Kanawha Coal Operators Association.

▸ *JOY MFG. CO.*—John D. Russell, vice president in charge of engineering.

▸ *TUBE TURNS PLASTICS, INC.*—Earl Erich, on the company's technical service staff.

▸ *INDUSTRIAL UNIT HEATER ASSOCIATION*—W. H. Rietz, president; T. R. Peyrek and I. W. Clark, vice presidents. Mr. Rietz is executive vice president of Ilg Electric Ventilating Co., Mr. Peyrek is manager of the heating and ventilating division of the L. J. Wing Mfg. Co., and Mr. Clark is manager of the heating and ventilating department of American Air Filter Co.

▸ *AUTOMATIC DEVICES CO., INC.*—H. Forrest Oakes, national sales manager. Mr. Oakes will supervise and coordinate sales, promotion and advertising through distributors and dealers.

▸ *CHASE BRASS & COPPER CO.*—Glenn P. Bakken, a director and executive vice president.

▸ *PERFECTION INDUSTRIES, INC.*—Manning E. Case, secretary and treasurer.

▸ *WILLIAM WALLACE CO.*—George B. McClellan, sales promotion manager for the company, manufacturer of gas vent pipe.

▸ *BALDWIN-HILL CO.*—E. R. Stevens, executive vice president; M. M. Wilson, vice president in charge of sales.

▸ *BRUNNER MFG. CO.*—Paul A. Hunker, sales manager; Wallace C. Roberts, advertising and sales promotion manager; Charles M. Heathman, sales staff.

▸ *KULJIAN CORP.*—Harry A. Kuljian, "Engineer for 1954." The award is given annually by the Pennsylvania Society of Professional Engineers.

▸ *NATIONAL RADIATOR CO.*—Robert D. Barron, plant manager in Johnstown, Pa., succeeding John E. Harris, who has been named manager of engineering at the company's Viking Air Conditioning Div. in Cleveland.

▸ *DE LAVAL STEAM TURBINE CO.*—D. T. Bixby, sales manager of the company's Standard Products Div.

▸ *TORRINGTON MFG. CO.*—M. A. Joulsohn, vice president.

▸ *YORK DISTRIBUTORS, INC.*—Nils D. Sellman, commercial and residential department manager of the Wholesale Div.

▸ *TANN CORP.*—William M. Smart, sales manager of the Congress Drives Div.

▸ *SUNBEAM AIR CONDITIONER DIV., AMERICAN RADIATOR & STANDARD SANITARY CORP.*—Nine cooling sales engineers added to the field sales force and their territories are: James I. Bickley, Baltimore, Washington, Philadelphia and Richmond; W. D. Campbell, Pittsburgh, Buffalo and Tri-State area; H. I. Dingle, Texas; C. E. Johnson, Chicago, Wisconsin, Illinois, Minnesota and Omaha; T. J. Conway, St. Louis and Kansas City; Maurice G. Nelson, Cincinnati, Cleveland, Ohio and Detroit; John B. Mitchell, Boston, New York and Newark; Lester G. Simpson, New Orleans; Robert T. Watt, Atlanta.

▸ *FIELDEN INSTRUMENT DIV., ROBERTSHAW-FULTON CONTROLS CO.*—A. W. Roat, field sales representative in northern Ohio and parts of northwest Pennsylvania; Electro Products, Inc., Indianapolis distributor; Broger Instrument Sales Co.. Inc., distributor in the Boston area.

▸ *POWERS REGULATOR CO.*—Quentin P. Thompson and Jack R. Wilson, branch managers for the company's new factory branches in Buffalo and Denver, respectively.

▸ *ALCO VALVE CO.*—Newly appointed field engineers and their territories are: Roy G. Trafton, Louisiana and surrounding area; Jerrell J. Cassady, Minnesota area; Robert E. Spence, New England; Jack L. Barley, Pennsylvania territory.

▸ *MITCHELL MFG. CO.*—N. H. Lieberman Co., Inc., distributors for room air conditioners in Minnesota, North Dakota and northwestern Wisconsin; Medill Corp., southeastern Pennsylvania representative; Allied Distributing Co., Nebraska and western Iowa distributor; August H. Jaeger, representative in Washington and Oregon.

▸ *ECLIPSE FUEL ENGINEERING CO.*—E. C. Konkle Co., distributor in Virginia with offices in Richmond and Roanoke.

▸ *CHILDERS MFG. CO.*—P. J. O'Meara Co., sales and engineering representative in northern California and Nevada.

▸ *GENERAL CONTROLS CO.*—A. E. Hess, southwest regional manager with headquarters in Dallas; W. K. Walters, Houston branch office manager.

▸ *DRAYER-HANSON, INC.*—J. W. Joiner Co., representative in Dallas and northeastern Texas.

▸ *NATIONAL SUPPLY CO.*—Sales offices of the Spang-Chalfant Div. in New York have been moved to 45 Rockefeller Plaza. Former offices were at 600 Fifth Ave.

▸ *STRONG, CARLISLE & HAMMOND CO.*—Seco Industries, Inc., New York and northern New Jersey distributor; Rhodes Equipment Co., representative in the St. Louis area.

▸ *TUBE TURNS*—New district managers for the company's western division: L. O. Morris, Tulsa; Daniel V. Pisano, San Francisco; Norton P. Bosemer, Los Angeles; and E. R. Muir, Jr., Seattle.

▸ *SERVEL, INC.*—S. J. Grimm, manager of the Evansville sales branch, the company's wholesale distributing outlet for southwestern Indiana, southeastern Illinois and western Kentucky.

▸ *STERLING ELECTRIC MOTORS, INC.*—Charles E. Cotham, Houston district manager.

▸ *INTERNATIONAL NICKEL CO., INC.*—E. A. Tice, transferred to the company's development and research division's New England technical field section at Hartford, Conn.

▸ *CLEAVER-BROOKS CO.*—Tamco Engineers, San Francisco, northern California and western Nevada representative.

▸ *AMANA REFRIGERATION, INC.*—Cladco Murray, Inc., western New York and five adjacent counties in Pennsylvania; Circulex, Ltd., British Columbia representative.

▸ *OHIO BRASS CO.*—J. T. Roselle, district manager of the company's valve department in New York City.

▸ *HALSTEAD & MITCHELL*—Harry R. Smith, representative in the area surrounding Pittsburgh.

▸ *WILLIAM WALLACE CO.*—George J. Torassa, appointed to New York sales staff of the company's Metalbestos Div.

▸ *BRISTOL CO.*—Alden H. Webber, sales engineer in the Seattle area.

▸ *IRON FIREMAN MFG. CO.*—Albert L. Niemoller, manager for commercial-industrial equipment sales in Portland, Ore.; Jack Hune, district sales manager for Oregon and parts of Washington and Idaho.

▸ *UNION ASBESTOS & RUBBER CO.*—Heating and Cooling Products, Inc., a Chicago distributor.

WE HEAR THAT . . .

▸ *JIM OWENS, MERCOID CORP.*, national chairman of the Old Timer's Club of The Oil Burner Industry, announces that arrangements have been made for the annual meeting and dinner party during the time of the *OIL HEAT INSTITUTE* meeting. The date is Wednesday, April 20, at the Western Society of Engineers, Chicago.

▸ The new *L-O-F GLASS FIBERS CO.*, recently formed by the merger of *GLASS FIBERS, INC.*, into the former *LIBBEY-OWENS-FORD* subsidiary, officially began operations March 1. The new board chairman is *GEORGE P. MacNICHOL, JR.*, who is also president of Libbey-Owens-Ford.

▸ *RELIANCE ELECTRIC & ENGINEERING CO.* has negotiated for the acquisition of the *REEVES PULLEY CO.*, it has been announced by *J. W. COREY*, president of Reliance.

▸ *ORR AND SEMBOWER, INC.* recently marked its 70th year as a manufacturer of steam boilers.

▸ Approval of the merger of *AFFILIATED GAS EQUIPMENT, INC.* into *CARRIER CORP.* was voted recently at stockholders' meetings of both companies. The move became effective March 1, *CLOUD WAMPLER*, president and chairman of Carrier, stated.

▸ *INLAND STEEL CO.* has unveiled plans for its all stainless steel skyscraper to be built in Chicago. Cellular type flooring will provide radiant heating and air conditioning.

▸ *THE BARRY CORP.* has announced the acquisition of 8 acres of land adjoining its Watertown, Mass. plant. The land is to be used for the future expansion of the company.

▸ An offer by *GENERAL CONTROLS CO.* to purchase the assets of the *CONTROLS AND INSTRUMENT DIV.* of the *PERFEX CORP.* has been accepted, it has been announced by *W. A. RAY*, president of General Controls. The transaction involves the purchase of the assets of this division of Perfex in return for an undisclosed amount of General Controls preferred and common stock, Mr. Ray states.

▸ During a one day meeting held in Dayton recently, *AIRTEMP DIV., CHRYSLER CORP.* officials reviewed the firm's 1955 line of room air conditioners, along with sales prospects and merchandising plans. More than 45 distributor representatives from leading midwest cities attended.

▸ *PENN INDUSTRIAL INSTRUMENT CORP.* by corporate merger has become a division of *BURGESS-MANNING CO.*, it has been announced by *RALPH L. LEADBETTER*, president.

▸ *JOSEPH P. BINNS*, executive vice president and general manager of The Waldorf-Astoria and vice president of the Hilton Hotels Corp. in charge of operations in the East, has announced the winning of the Safety Award Cup of The Waldorf-Astoria by the engineering department for 1954. The trophy was presented to *THOMAS J. BARRETT*, building superintendent, by *WALLACE W. LEE, JR.*, manager of the Waldorf.

▸ *WOLVERINE TUBE, DIV. OF CALUMET & HECLA, INC.* has opened a new mill depot in Minneapolis stocking copper water tube, automotive tube and refrigeration tube.

▸ *WEKSLER THERMOMETER CORP.* has relocated in new quarters in Freeport, Long Island. The new one story plant houses 25,000 sq ft of office and production space. Weksler had previously been located in New York City.

▸ *PERFECTION STOVE CO.* stockholders have voted to change the name of the company to *PERFECTION INDUSTRIES, INC.* This was brought about since the scope of the company's operations has been substantially broadened since the adoption of the old name in 1925.

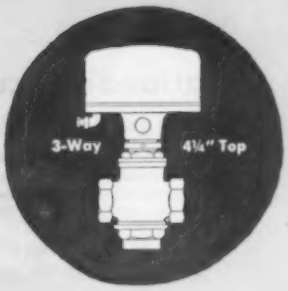
▸ *SUNDSTRAND HYDRAULIC DIV.* is now a separate entity with a new home, new name, and its own management, sales, engineering, service and production facilities, according to an announcement from *L. H. SCHUETTE*, vice president, *SUNDSTRAND MACHINE TOOL CO.*

▸ *AMERICAN DISTRICT STEAM CO, INC.* has changed its name to *ADSCO INDUSTRIES, INC.* and has set up two new operating divisions. The North Tonawanda, N. Y. plant operation has become the American District Steam Div. of ADSCO Industries, Inc., and the former California Steel Products Co. is now the California Steel Products Div.

▸ *VANTON PUMP & EQUIPMENT CORP.* announces the removal of its executive and sales offices to its plant location at Hillside, N.J.

POWERS

First with duo-seal PACKLESS CONTROL VALVES

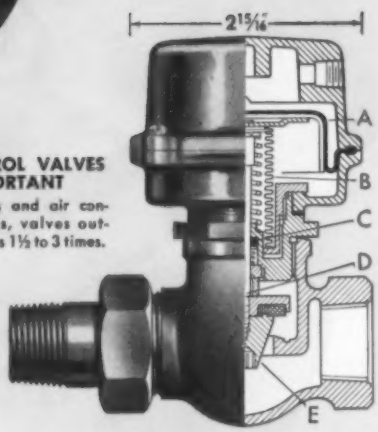


DURABLE AIRTIGHT CONSTRUCTION

GOOD CONTROL VALVES ARE IMPORTANT

On many heating and air conditioning systems, valves outnumber thermostats 1½ to 3 times.

Available in Various Types and Sizes

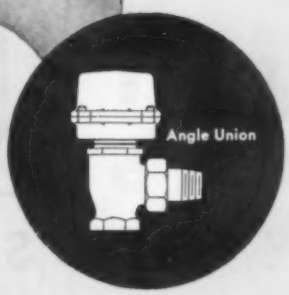


Rugged Cast Aluminum Top

A) Durable Molded Diaphragm
B) Bronze Bellows, Primary Seal
C) "O" Ring, Secondary Seal
D) Polished Stainless Steel Valve Stem
E) Characterized Throttling Nut

More ACCURATE Control with Powers PACKLESS Valves

Minimum valve stem friction. No packing nut or gland to be tightened, oiled or adjusted. No binding of valve stem as with conventional packing. Powers **duo-seal construction** assures better performance and—



No Packing Maintenance. No Leakage of Water or Steam. No Loss of Vacuum.

To insure getting a temperature control system with the best control valves made for convectors, unit air conditioners, unit ventilators, radiators, panel heating and cooling coils — specify or install POWERS control.

Call or write our nearest office for Bulletin 348

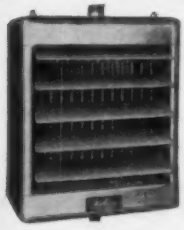
Established in 1891 • THE POWERS REGULATOR COMPANY • SKOKIE, ILL. • Offices in Over 60 Cities

(b72r)

National Biscuit Company
Chicago, Illinois

Architect: Alexander D. Crossett, New York, N. Y.
General Contractor: Ragnar Benson, Inc., Chicago, Ill.
Heating Contractor: Robert Gordon, Inc., Chicago, Ill.

Airtherm



90 VERTICAL DISCHARGE HEATERS INSTALLED from 102,500 BTU to 185,000 BTU

92 HORIZONTAL DISCHARGE HEATERS INSTALLED from 14,800 BTU to 250,000 BTU

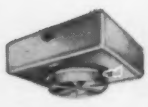
STEAM UNIT HEATERS

WARM THE WORLD'S LARGEST BAKERY

To achieve flexible, economical heating throughout Nabisco's new $20 million Chicago plant, 182 Airtherm steam unit heaters have been installed. The plant is the world's largest cracker and biscuit bakery with ovens the length of football fields, almost 20 acres of floor space and a capacity of 167 million pounds yearly.

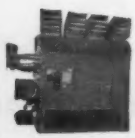
When the area to be heated presents unusual problems, chances are you can solve them easily and economically with the flexibility of Airtherm unit heaters.

Convectors


Vertical Steam Unit Heaters

Horizontal Steam Unit Heaters

Centrifugal Fan Type Unit Heaters


Direct Fired Space Heaters

Gas Fired Unit Heaters

FOR HEATING SATISFACTION . . . THINK FIRST OF

Airtherm MANUFACTURING COMPANY

700 South Spring Avenue • St. Louis 10, Missouri

Halstead & Mitchell

for LONG LIFE PROTECTION

COOLING TOWERS

with the exclusive

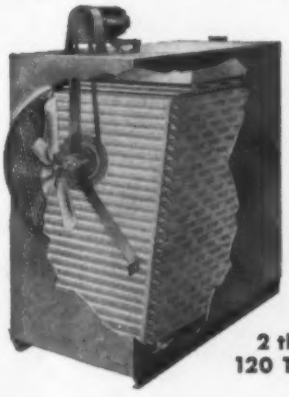
20-Year Guarantee!

on the wetted deck surface against rotting or fungus attack

YOU ARE GUARDED WHEN YOU CHOOSE A HALSTEAD & MITCHELL RESIDENTIAL OR COMMERCIAL TOWER

Only Halstead & Mitchell can offer a 20-Year Guarantee on the wetted deck surface against rotting or fungus attack because only Halstead & Mitchell creosotes cooling tower wood. No other material, subject to deteriorating or rusting, can be so guaranteed.

Stainless steel fans, sheet steel cabinets hydraulically painted with vinsynite, vinyl zinc and chlorinated rubber . . . add to this protection for the longest life. There's no extra cost for these extra protections . . . just extra long time benefits on the job.



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CONDENSERS

with economical

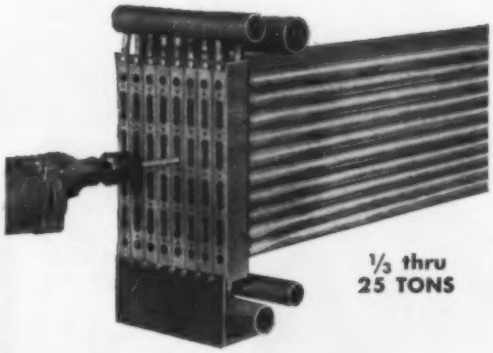
Lifetime Cleanability

for always-new efficiency

The cooling tower you select works with a condenser, and here again you are guarded by Halstead & Mitchell.

CLEANABILITY in a water-cooled condenser costs no more, but troubles from poor water conditions vanish. Heat transfer efficiency is maintained at new unit levels for life, for a simple mechanical cleaning tool restores heat transfer surfaces in minutes.

Regardless of whose condensing unit you buy, do what almost all leading manufacturers have done — specify CLEANABILITY. It's your most important protection . . . why settle for less?



⅓ thru 25 TONS

AT LEADING HEATING AND REFRIGERATION WHOLESALERS EVERYWHERE

Write for Detailed Specifications

HM Halstead & Mitchell

BESSEMER BUILDING • PITTSBURGH 22, PA.

ONE MAN INSTALLS 18 TO 20 AIR CONDITIONERS DAILY— This air-conditioning unit was installed on the ceiling at Chicago's Hotel Drake in only 20 minutes . . . using a RAMSET JOBMASTER with internally threaded fasteners. It is one of the many uses of RAMSET SYSTEM which save the Hotel Drake $8,500 per year on a $120 investment.

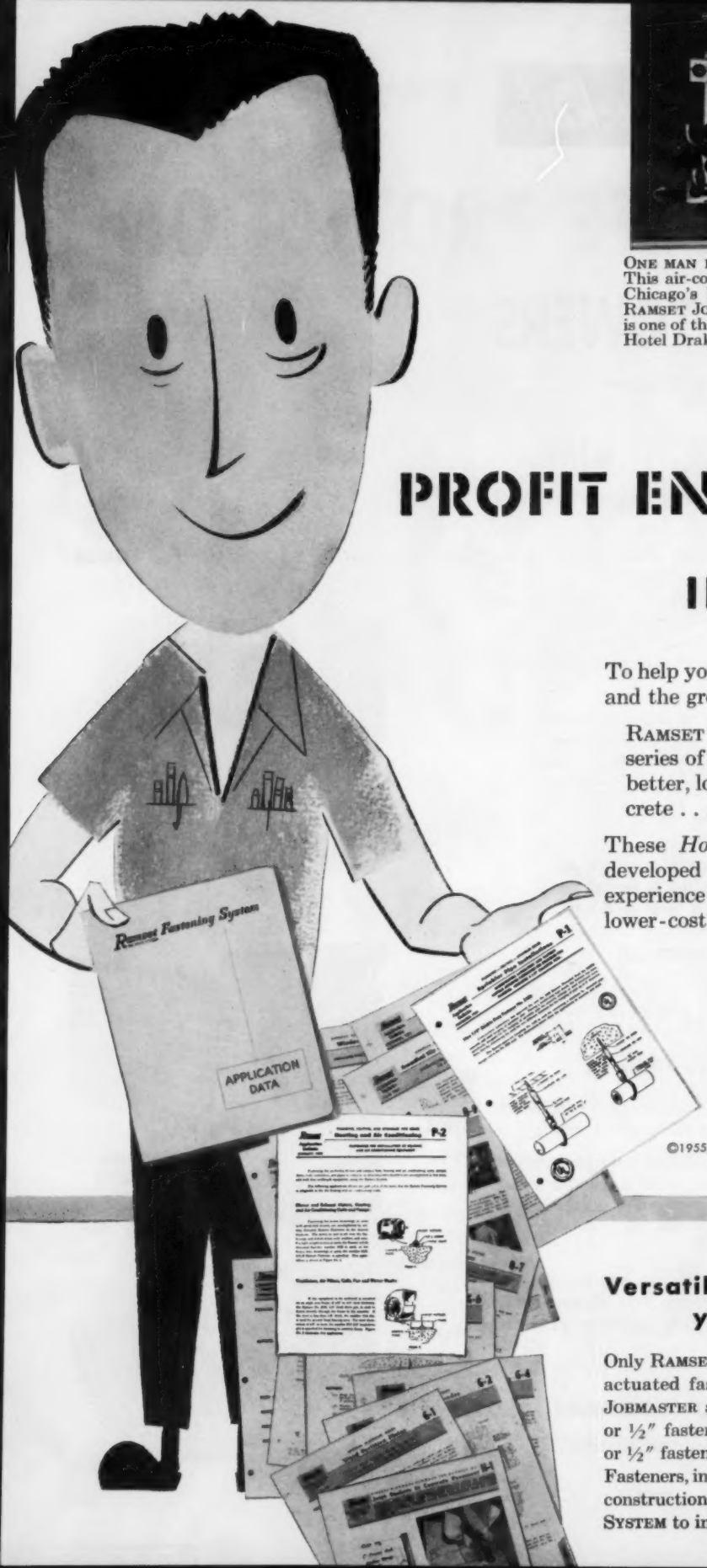
PROFIT ENGINEERING

INCREASE YOUR

To help you meet tougher competitive conditions and the growing pressure for lower costs . . .

RAMSET PROFIT ENGINEERING offers a new series of specific, proved methods for faster, better, lower-cost fastening into steel or concrete . . . to increase your PROFIT MARGINS.

These *How-to-do-it Data Sheets* have been developed from 7 years of tested and proved experience in actual construction. You'll find lower-cost methods which you can apply to



Ramset

RAMSET DIVISION

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Versatility of Ramset System helps your PROFIT MARGIN!

Only RAMSET SYSTEM offers such a wide range of powder-actuated fastenings. The low-cost tool combination of JOBMASTER and PLUS POWER JOBMASTER will set ¼", ⅜" or ½" fasteners. The SUPER-POWER JOBMASTER sets ⅜" or ½" fasteners for heavy duty work. Six types of Tru-Set Fasteners, in 76 sizes, permit selection to meet almost every construction fastening need. You can't match RAMSET SYSTEM to increase your PROFIT MARGINS.

RAMSET SAVED $11,000 FOR JOSKE—By speeding and simplifying fastening work in Joske's San Antonio store, $11,000 in alteration costs was saved on 2 miles of air-conditioning ducts, and 13 miles of sprinkler piping.

SAVES 75% OF FASTENING TIME—For anchoring sheet steel wall, North American Aviation used about 20,000 individual fastenings, set 50 per hour per man . . . at least 4 times faster than old-fashioned methods.

PIPE HANGERS SET FASTER WITH RAMSET—At Oklahoma City's Biltmore Hotel, new piping is hung 5 times faster by using RAMSET Fasteners in overhead concrete. Note one-hand operation in cramped space.

CAN HELP YOU PROFIT MARGINS

installing piping, sheet metal, sprinkler systems, duct straps, controls and many other kinds of day-by-day fastening jobs.

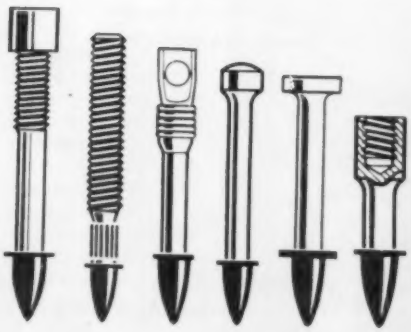
They help you apply the versatile RAMSET SYSTEM to light, medium or heavy-duty work. They specify which RAMSET tools, fasteners and power charges will do the work most effectively.

Ask your local RAMSET dealer for your Data Sheets, or use the handy coupon, and see for yourself how RAMSET SYSTEM can increase your PROFIT MARGINS.

Fasteners, INC.

OLIN MATHIESON CHEMICAL CORPORATION

12109 BEREA ROAD • CLEVELAND 11, OHIO



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THERE'S AN

EXTRA DIVIDEND IN

STEEL PIPE!

There are plenty of good reasons why you get top-quality pipe when you buy SPANG CW. But the very careful steps used to test and inspect SPANG CW Pipe prior to shipping give you an "extra dividend" that pays off in top-quality installations. Here's what we mean:

TESTING. Each length of SPANG Pipe is subjected to a hydrostatic test, the final check to make sure the weld is sound. Test pressures applied are well above actual requirements.

INSPECTION. Threads and couplings are gauged and measured for length, pitch and quality. Each length of pipe is inspected visually inside and out with the aid of light from fluorescent tubes to be positive that it meets SPANG's high product requirements.

To these two factors add quality steel, automatically-controlled furnaces, and the latest developments in mechanized production. Result: consistently good quality pipe for every type plumbing, heating, air conditioning, radiant heating and snow melting installation.

Why buy just any pipe when you can get top-quality SPANG Pipe at no extra cost? Specify SPANG CW Steel Pipe for your next installation.

SPANG-CHALFANT

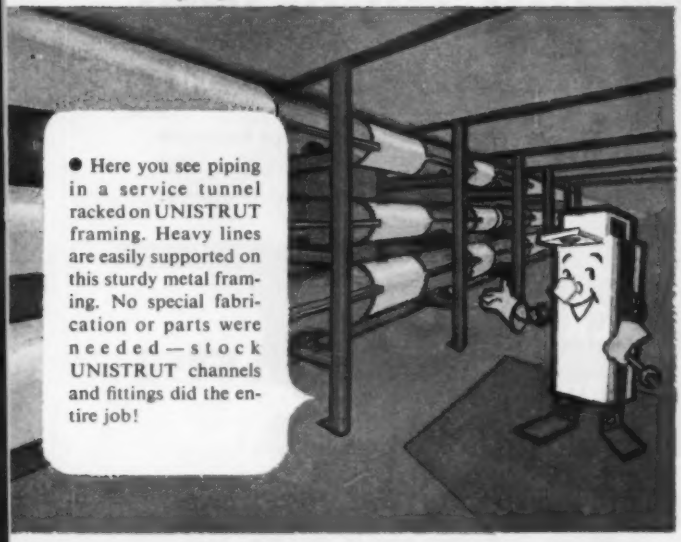
DIVISION OF THE NATIONAL SUPPLY COMPANY

General Sales Office: Two Gateway Center, Pittsburgh, Pennsylvania. District Sales Offices: Atlanta, Boston, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis.

"The Sky's The Limit"

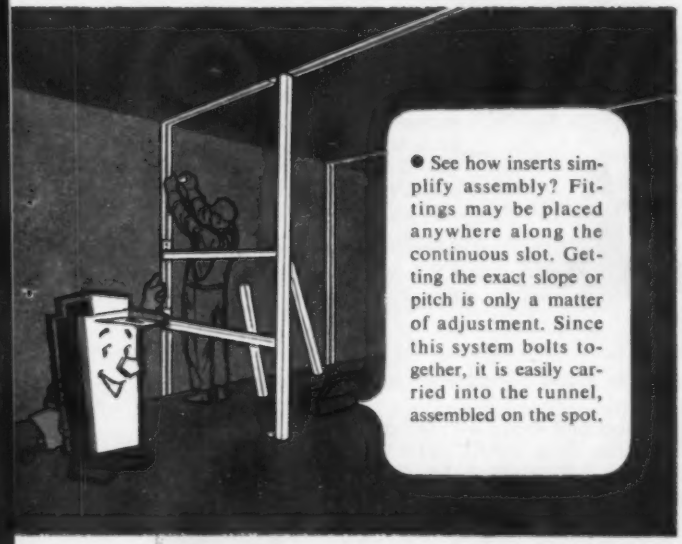
—when you build with UNISTRUT®

Mr. Strut simplifies pipe racking with cost-cutting UNISTRUT® framing

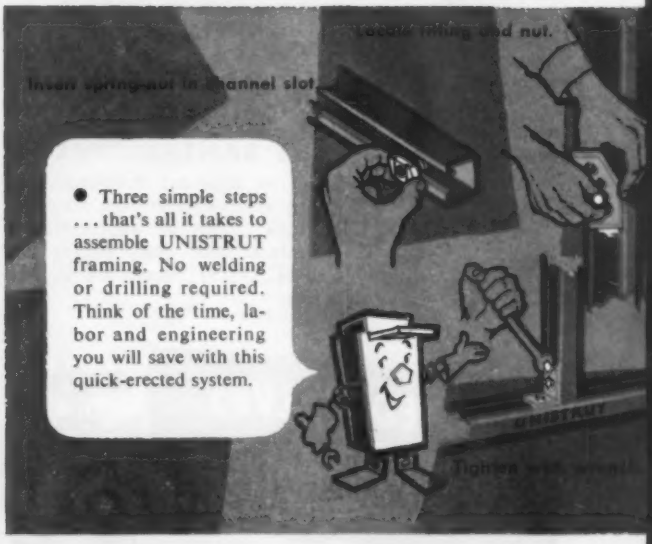


● Here you see piping in a service tunnel racked on UNISTRUT framing. Heavy lines are easily supported on this sturdy metal framing. No special fabrication or parts were needed—stock UNISTRUT channels and fittings did the entire job!

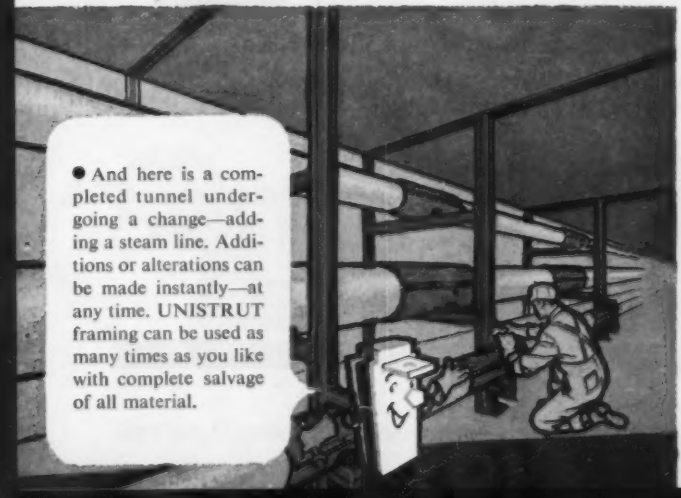
● Everything you need to rack heavy water lines to light conduit—clamps, concrete inserts, hangers, rollers and many other accessories are standard parts of the *complete* UNISTRUT system. Especially useful are these UNISTRUT concrete inserts.



● See how inserts simplify assembly? Fittings may be placed anywhere along the continuous slot. Getting the exact slope or pitch is only a matter of adjustment. Since this system bolts together, it is easily carried into the tunnel, assembled on the spot.



● Three simple steps ... that's all it takes to assemble UNISTRUT framing. No welding or drilling required. Think of the time, labor and engineering you will save with this quick-erected system.



● And here is a completed tunnel undergoing a change—adding a steam line. Additions or alterations can be made instantly—at any time. UNISTRUT framing can be used as many times as you like with complete salvage of all material.

Why not take advantage of this versatile system on your next job? You'll find it does a faster, better job for less money. Your UNISTRUT Distributor knows this system well and can assist you in design and engineering. See him for complete information and the new low price of UNISTRUT framing. Send the coupon below for free catalogs. Make a note, too, to see our latest film "The Sky's The Limit" —now at your UNISTRUT Distributor's.

Complete warehouse stocks in all principal cities. In Canada, Northern Electric Company.

The World's Most Flexible All-Purpose Metal Framing

U. S. Patent Numbers
2327587 2380379
2329815 2405631
2345650 2541908
2363382 2696139
other patents pending

UNISTRUT PRODUCTS COMPANY
1013 W. Washington Blvd.
Chicago 7, Illinois
Dept. H-6

☐ mechanical and electrical catalog No. 700
☐ information on UNISTRUT film, "The Sky's The Limit."

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Company.....
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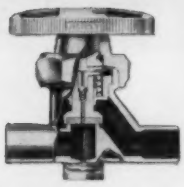
HENRY LINE VALVES really give you something extra

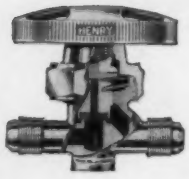
They give more dependable service because of advanced field-proven design and construction as well as patented features.

PACKLESS VALVES FOR FREON with Exclusive Balanced-Action



STANDARD TYPE

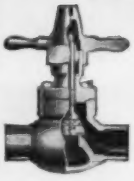
Ball check in balancing channel permits diaphragm inspection and replacement with valves under line pressure. Sizes, ¼" thru ⅝" flare; ¼" thru 1⅝" O.D. Solder, ¼" thru ½" F.P.T.



BLUE BANTAM TYPE

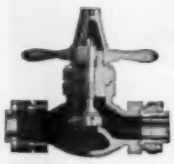
Same as standard Balanced-Action valve except that diaphragms cannot be inspected or replaced under line pressure. Size ¼" thru ⅝" flare and O.D. Solder.

PACKED VALVES FOR FREON Bronze-Wing Cap Type



Globe and angle types with solder connections, bolted bonnets, sizes ⅞" thru 4⅛" O.D.

SEMI-STEEL WING CAP TYPE



With bolted bonnets and square companion flanges. Furnished with brass tailpieces (O.D. Solder) 1⅜" thru 5⅛" or with steel tailpieces for welding to pipe, sizes 1¼" thru 5".

Also Globe and angle types with F.P.T. connections, sizes ½" thru 2".

PACKED VALVES FOR AMMONIA Permanent-Mold Iron and Semi-Steel

Compact and strong with self-aligning stem disc. Sizes (F.P.T.), screw bonnet: ¼" thru 1", bolted bonnet 1¼" thru 2"—with flange connections 1¼" thru 5".

HENRY—Standard equipment by leading Manufacturers, Army, Navy, Coast Guard and Maritime Commission • Stocked by Leading Jobbers

WRITE FOR CATALOGS

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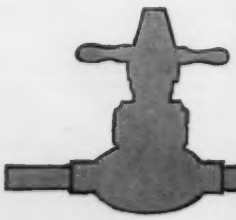

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CABLE: HEVALCO, MELROSE PARK, ILLINOIS

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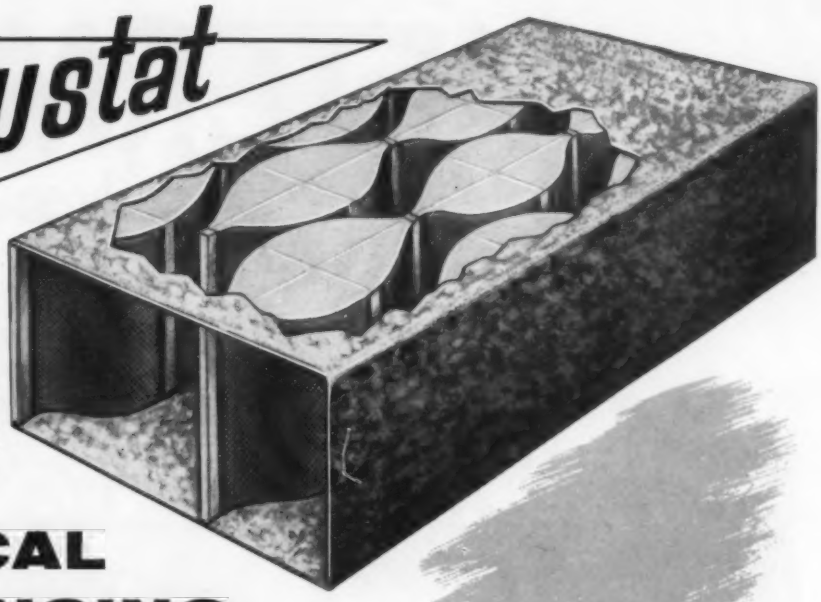
Aircoustat



PRACTICAL SILENCING

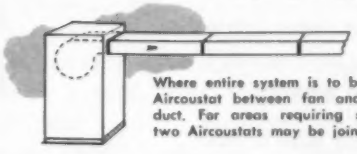
for AIR CONDITIONING SYSTEMS

Aircoustat is a compact, *completely packaged* unit for silencing fan and air noise in air conditioning systems. Easily installed directly into the duct work, Aircoustat eliminates the need for costly, extensive duct lining. And results are astonishing: one *7 foot* unit reduces noise level below what *100 feet* of commercial duct lining could accomplish.

Engineered to provide broad band attenuation with low pressure drop, Aircoustat is available in 14 standard sizes for use with all styles and sizes of duct, and 8 types to meet any desired conditions. Selection is no problem: ***if it fits geometrically, it fits acoustically.***

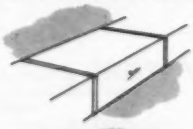
Where to install Aircoustat

Aircoustats are incorporated as part of the duct work. If only selected areas require quiet, install above individual diffusers.

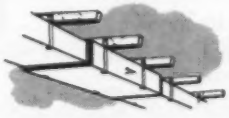


Where entire system is to be silenced, insert Aircoustat between fan and first length of duct. For areas requiring special silencing, two Aircoustats may be joined in series.

How to install Aircoustat



Aircoustat requires no special tools for installing. It is constructed to be joined to ductwork with a lock seam.



If ductwork and Aircoustat differ in size, a canvas or asbestos coupling may be used. If ductwork is hung, support Aircoustat similarly.

Mail this coupon TODAY ▶▶▶

SILENCE SERVICE

Industrial Sound Control Inc.
45 Granby Street, Hartford 12, Conn.

INDUSTRIAL SOUND CONTROL, INC.
45 Granby St., Hartford 12, Conn.
Please send me more information on AIRCOUSTAT.

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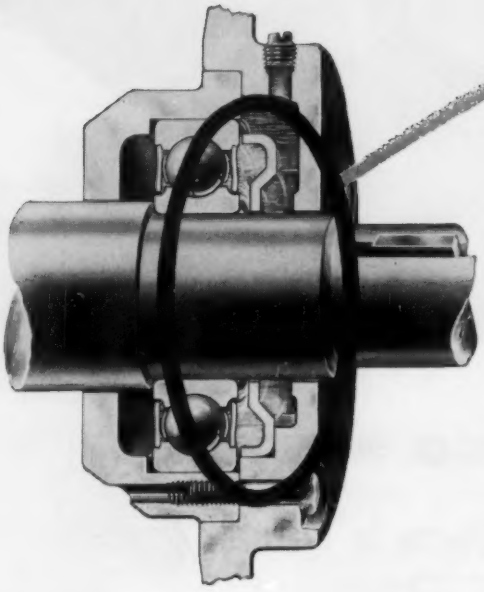
RELIANCE METERMATIC

You can't grease 'em wrong!



NEW METERING PLATE

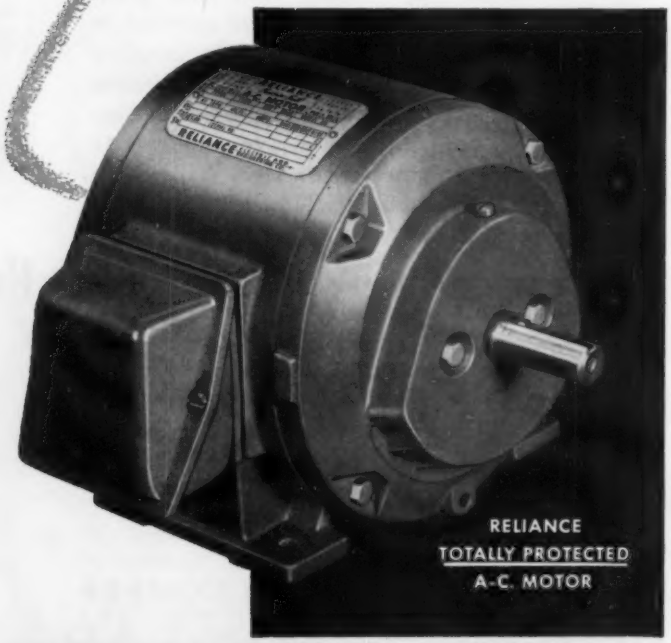
provides the right amount of lubrication for A-c. and D-c. motors

No over or under lubrication is possible . . . you *can't* grease 'em wrong!

This is your sure answer to reliable greasing to eliminate burned-out motors.

Grease is *metered* to the bearing in just the *right amount* at all times.

Get in touch with the Reliance sales office or distributor near you for more details. A-1492



RELIANCE Super LINE

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Builders of the Tools of Automation

RELIANCE *Precision-Built* MOTORS

"a size for every need"...

UTILITY'S FULL LINE OF UNIT HEATERS

Now you can be sure of exactly the right unit for those problem installations that demand high heating power *and* a handsome, compact heater. Utility's unit heaters are available in 50, 75, 100, 125, 150 and 225 thousand BTU capacities to meet every demand. Each one has been attractively designed to please the most particular client.

Check these advantages: porcelain enameled heat exchangers; low 24-voltage controls; slow speed motor for whisper-quiet operation; high efficiency heat exchangers; summer ventilation switch; fully automatic; AGA-approved. You'll see why these competitively priced Utility Unit Heaters will help you sell the job and keep your customers happy!

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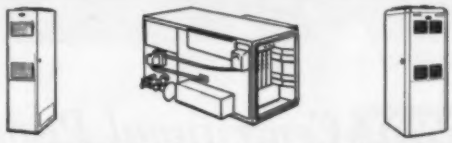
a happier living family tree . . . all branches of



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Sodium sulphate • Asbestos fiber & cement mix • Green liquor •
Soap solution • Grinder coolant • Carbon slurry • Cane wash • Salt brine • Sea water •
• Caustic solution • Bleach liquor • Grape juice concentrate • Tomato juice concentrate •
Tomato puree • Propanol • Soap liquor • Cane juice • Aqueous lime • Coke oven oil •
• Paper stock • Waste sulphite liquor • Alkylaryl sulfonate • Sugar liquor • Vinyl pyridine
• Saturated brine • Grape juice • Tomato juice • Press liquor • Calcium bisulphite • Melt
Phenolized ammonia • Ammonia liquor • Sulphuric acid • Paraffine oil and water • Sludge
• Milk waste • Gritty water • Cane syrup • Lime & soda solution • Cachaza • Clear juice
White water • Mineral oil • Chromic acid Cement • Gasoline • Depanol
Brine • Vegetable oil • Licorice liquor • Flume water •
• River water • Benzine thinner • Mash
Methylene chloride • Sodium hydroxide
Sizing solution • Alcohol •
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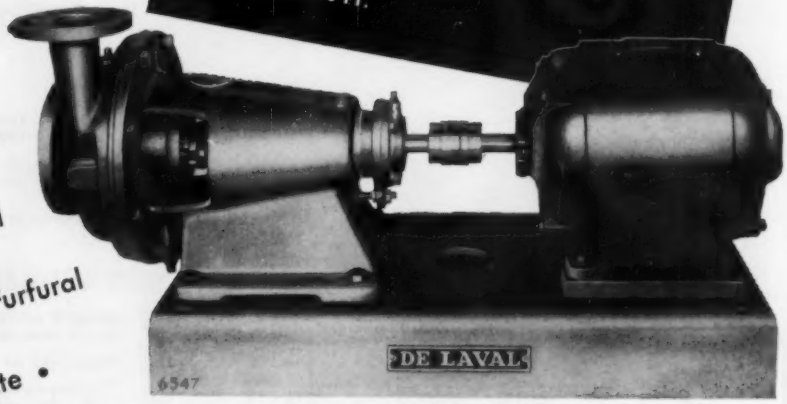
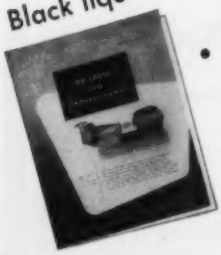
Black liquor • Ethylene glycol
• Fuel oil • Furfural
• Condensate •

One pump handles all these liquids...

DE LAVAL CPO PROCESS PUMP

CAPACITIES TO 2,000 GPM
HEADS TO 200 FT.





WRITE FOR BULLETIN 1125-B

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
871 Nottingham Way, Trenton 2, New Jersey

DL 381

These are Zallea Pressure-Balanced Expansion Joints. They provide a sound engineering solution to the problem of absorbing pressure thrust where a change in direction occurs, and it is not possible to anchor the elbow.

Their operation is simple. Both expansion joints shown are designed to absorb axial and lateral movement in the inboard bellows. By means of tie rod action, the pressure thrust of the inboard bellows is balanced by the countermovement of the outboard bellows. This design is frequently used in piping connections to a turbine to eliminate the pressure thrust against the turbine casing. Many other applications may occur to the design engineer.

An original Zallea design, these specialized joints are another example of our ability to develop, engineer and manufacture expansion joints to meet your specific needs. For information on standard types, or help with special expansion or piping problems, call in a Zallea representative.

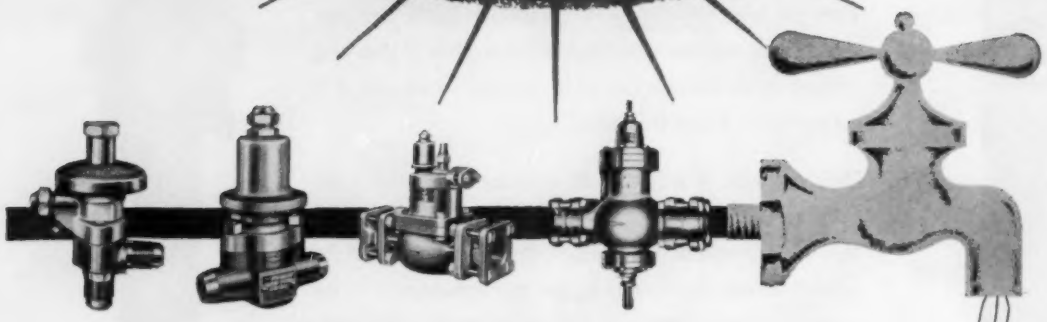
Zallea *expansion joints*

ZALLEA BROTHERS, 816 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints

"anti-freezers"

FOR YOUR WATER COOLERS



ALCO evaporator pressure regulators

They maintain constant evaporator pressure under all load conditions.

Result: Efficient cooling without freezing—no busted coolers!

For any size water cooler from drinking fountains to large industrial jobs.

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ALCO VALVE CO.

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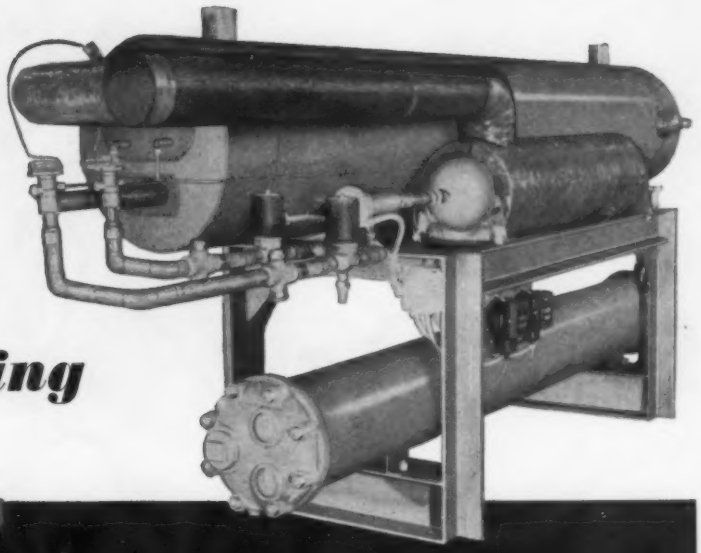
Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

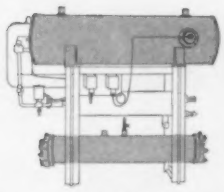
6316

flexible air conditioning

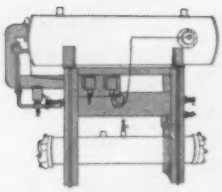


IN A PACKAGE!

Acme FLOW-THERM® PACKAGED LIQUID CHILLER

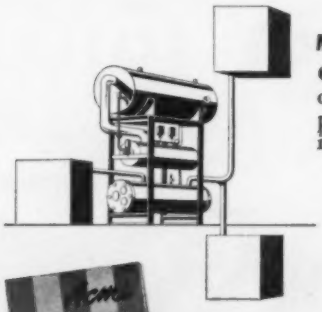


CHILLER AND COMPRESSOR are selected by Acme-simplified procedures to fit exact job requirements.



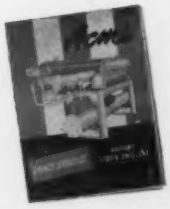
REFRIGERANT CONTROLS — and welded steel framework, complete the Acme Engineered Package.

For air conditioning systems or industrial processing applications in the range of 15 through 220 tons, here's the ideal "package." It's complete — less compressor — with all controls, piping and wiring factory installed and tested, ready for simple compressor connections. A truly flexible package, because the major components — famous Acme Dry-Ex Chiller with through tube construction, Shell-and-Tube Condenser(s) and Heat Exchanger are custom-selected for the exact capacity needed. Engineering time on a job is reduced appreciably, cost estimating is more accurate and installation is simple, fast and economical. Investigate Acme's Flow-Therm — both you and your client will benefit significantly. Units are ideal for Heat Pump applications.



MOUNT YOUR COMPRESSOR ANYWHERE — SAVE FLOOR SPACE AND HEAD ROOM

Compressor of any make or model can be mounted either above, below or to one side of the Flow-Therm. The inherent compactness of the Acme components, together with their compact arrangement and close-connected piping, makes for space-saving size in all Flow-Therm units.



Write today for Acme's new catalog on the Flow-Therm Packaged Liquid Chiller.

ACME AIR CONDITIONING REFRIGERATION

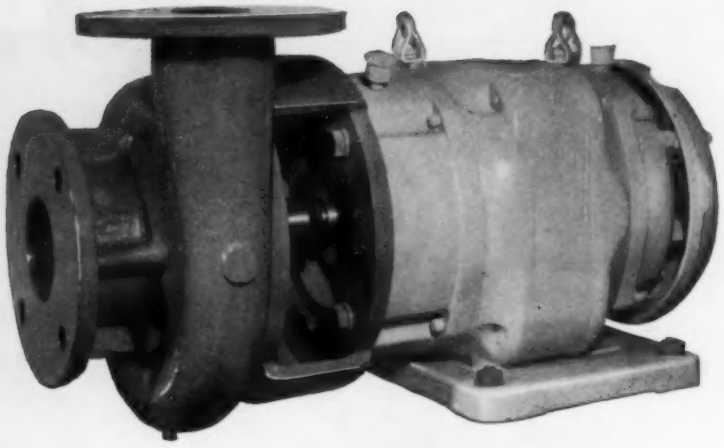
ACME INDUSTRIES, INC.

JACKSON, MICHIGAN

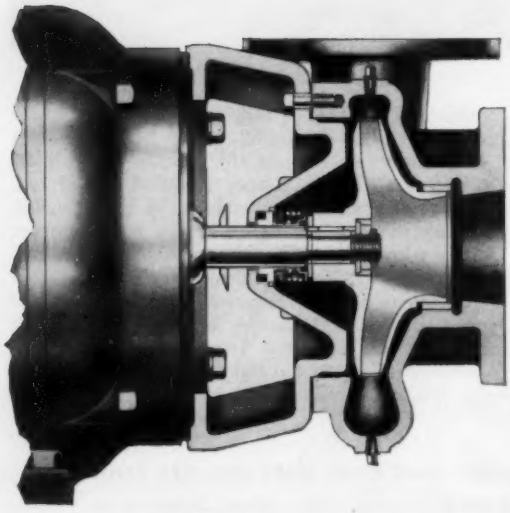
Manufacturers of Quality Air Conditioning and Refrigeration Equipment since 1919

- Evaporative Condensers
- Cooling Towers — 2 to 70 tons
- Ble-Cold Unit Coolers
- Dry-Ex (direct expansion) Liquid Chillers
- Shell-and-Tube, Shell-and-Coil Condensers
- Flow-Cold packaged Liquid Chillers to 15 tons
- Flow-Therm packaged Liquid Chillers to 220 tons
- Heat Exchangers
- Liquid Receivers
- Flow-Temp Heat Pumps
- Remote Room Conditioners
- Oil Separators

CHICAGO CC CLOSE-COUPLED PUMPS



Now Offered in More Sizes, Capacities From 5 to 550 G. P. M. Pressures From 10 to 275 Ft.



THE LEAK-PROOF CHICAGO MECHANICAL SEAL

- ***No maintenance or adjustment.***
- ***No expensive piping is needed from drip pocket to drain.***

It consists of a carbon ring face rotating on a stationary ceramic seat which is extremely hard and resistant to wear. The wearing surfaces are held under tension by a stainless steel coil spring and synthetic rubber bellows which provides automatic adjustment for wear and radial and axial shaft movement. The precision lapped sealing faces insure a perfect watertight seal preventing leakage. The entire assembly is resistant to wear and corrosion.

Complete line includes 10 sizes with threaded or flanged connections

Now, it's possible to get quick delivery on compact, end suction single booster and circulating pumps to fit your installations. Chicago Pump Company has expanded its line of close coupled centrifugal pumps to include models from 5 to 550 gpm capacities for heads from 10 to 275 feet.

The Chicago CC pump requires minimum space, eliminates coupling and alignment problems and can be installed in any position. The heavy duty motor has proved dependable in service, operates quietly without vibration. Easy-to-use selection tables for these pumps are included in Bulletin 108. Write for a free copy.

Suggested CC Pump Applications

- WATER SUPPLY SYSTEMS
- COOLING TOWER CIRCULATING
- AIR CONDITIONING SYSTEMS
- HOT AND CHILLED WATER CIRCULATING
- PNEUMATIC WATER SYSTEMS
- BOOSTER SYSTEMS

CHICAGO PUMP COMPANY

Subsidiary of Food Machinery and Chemical Corporation

BUILDING and INDUSTRIAL DIVISION

622 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

Cande-Vac, Sure Return, AVC, LVC, Fire, House & Circulating Pumps Pneumatic & Tankless Water Systems.

Flush-Kleen Sewage Ejectors Little Giant & Non-Clog Bilge Pumps Pumps for every industrial use.

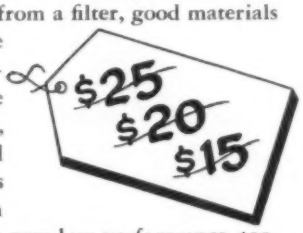
Random Thoughts from a Filter Engineer

by Harold R. Sobeck

- **HOW LOW CAN YOU CUT FILTER PRICES AND STILL GET VALUE?**
- **THE CLIP THAT LOCKS EFFICIENCY IN**
- **WHY YOU SHOULDN'T WANT A 100% EFFICIENT FILTER**

HOW LOW CAN YOU CUT FILTER PRICES AND STILL GET VALUE?

For some time now there's been an industry trend toward lower and lower filter prices. We wonder if the trend hasn't reached the point of diminishing returns. For the buyer! In order to get reasonably good service and long life from a filter, good materials must be used. But with the emphasis on price, the manufacturer is under pressure to use cheaper materials, produce a cheaper filter and sell it for less. Sometimes the net result is a filter with a nice low price but with a new low performance, too.



Of course, we at Air-Maze have done our best to cut filter prices. We've done it by improving design and streamlining production. But we never skimp on materials. The result is the same high quality you've come to expect from Air-Maze, and often at a lower cost.

Alert consulting engineers and contractors realize price is only one factor in determining the value of a filter. The quality that goes into it and the service that goes with it are equally important. Filter costs should not be lowered at the expense of quality or service. Otherwise, the buyer suffers.

THE CLIP THAT LOCKS EFFICIENCY IN

You wouldn't think the clip on a filter panel holding frame vitally important. Yet if it doesn't function properly, you won't get an effective seal. And a poor seal, which allows dirt to by-pass the filter, can seriously cut the efficiency of the whole filter installation. In the past, holding frame clips have been the source of considerable trouble. They broke easily, creating a difficult replacement job in a filter bank.

Our answer to this problem is an adjustable clip of rugged spring steel. It can hold panels of different thicknesses. It has a fastener especially designed so that it can be quickly replaced in case of breakage. This adjustable spring clip holds panels snug, insuring a tight seal. It provides positive pressure against a sponge neoprene gasket. (Even this gasket is exceptional. It's oil-resistant to retain its shape and resiliency. It won't take a "set" the way a felt gasket will.)

Holding-frame clips that give a more effective seal are just one more way Air-Maze gives filter users the full efficiency built into every one of its filters.

WHY YOU SHOULDN'T WANT A 100% EFFICIENT FILTER

With all the talk about filter efficiency, it's easy to lose track of a simple fact. It's no trick at all to build a filter that would be almost 100% efficient. (A steel plate is one example of perfect filter efficiency.) But by building this efficiency into it, you'd have to sacrifice one or more other qualities that probably are equally important to you. For instance, high dirt-holding capacity, or low pressure drop, or small size or low cost. You can't increase efficiency without making sacrifices elsewhere. The best filter for you has to be a compromise of the qualities you want most.

Electromaze

And every filter should be an answer to a specific filtering problem. What's good for one installation may be poor for another. For example, the Electromaze gives you highest efficiency by trapping particles as small as 1/250,000 of an inch. But perhaps you don't need such high efficiency. Perhaps a lower-cost viscous impingement filter gives ample filtration to meet your needs. This problem of fitting the filter to the need is one that Air-Maze has been answering for 29 years. Why not let us help *you*. The Air-Maze Corporation, 25000 Miles Avenue, Cleveland 28, Ohio.

AFI MEMBER AIR FILTER INSTITUTE

AIR-MAZE

The Filter Engineers

AIR FILTERS • SILENCERS • SPARK ARRESTERS
LIQUID FILTERS • OIL SEPARATORS • GREASE FILTERS

Depend on LADISH

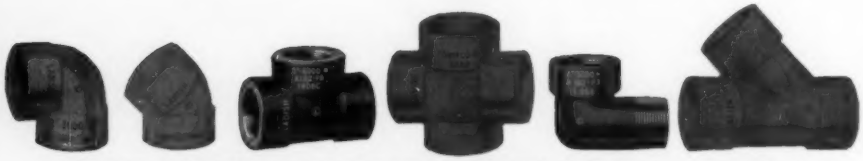
- Carbon Steels
- Carbon-Molybdenum Steels
- Chromium-Molybdenum Steels
- Nickel Steels
- Chromium-Nickel Steels
- Chromium-Silicon-Molybdenum
- Wrought Iron
- Chromium Type Stainless
- Chromium-Nickel Stainless
- Molybdenum Type Stainless
- Wrought Aluminum
- Aluminum-Copper Alloys

BUTT WELDING FITTINGS

½ inch through 42 inches . . .

FORGED CORROSION RESISTANT—LIGHT WEIGHT and A.S.A. FLANGES

½ inch through 24 inches . . .



FORGED SCREWED OR SOCKET WELDING FITTINGS and UNIONS

⅛ inch through 4 inches . . .

LARGE DIAMETER AND T.E.M.A.* STANDARD FLANGES up to 20 feet O.D.

*Tubular Exchanger Manufacturers Association

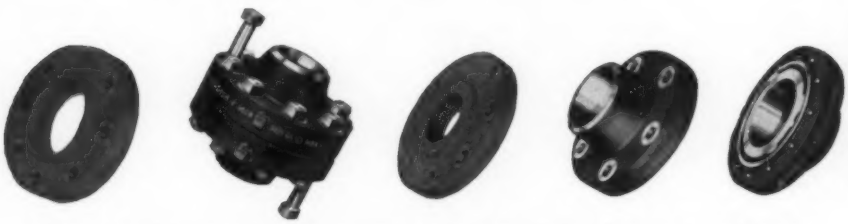
LONG WELDING NECKS

up to 24 inches, 150 lb. through 2500 lb.

Complete Service . . .

BUTT WELDING FITTINGS

Schedules 5S, 10S, 40S, 80S, and other Schedules and wall thickness.



FORGED CORROSION RESISTANT—LIGHT WEIGHT and A.S.A. FLANGES

150 lb. through 2500 lb. pressure ratings.

FORGED SCREWED OR SOCKET WELDING FITTINGS and UNIONS

150 lb. Corrosion Resistant and 2000 lb. through 6000 lb. ratings.

FOR FITTINGS FROM ANY FORGEABLE MATERIAL TO MEET YOUR SERVICE REQUIREMENTS

You get prompt, efficient service when you specify and order from the complete Ladish Controlled Quality line. Fittings *in any forgeable material* in virtually every type, size, wall thickness or pressure rating . . . are produced to one uncompromising Controlled Quality standard . . . and identified with heat code symbols pioneered by Ladish as verification of metallurgical integrity resulting from exhaustive tests made in the Ladish metallurgical laboratories.

For *complete service* on your fittings requirements, depend on the Ladish line and the services of your Authorized Ladish Distributor.

THE COMPLETE *Controlled Quality* FITTINGS LINE

LADISH CO.

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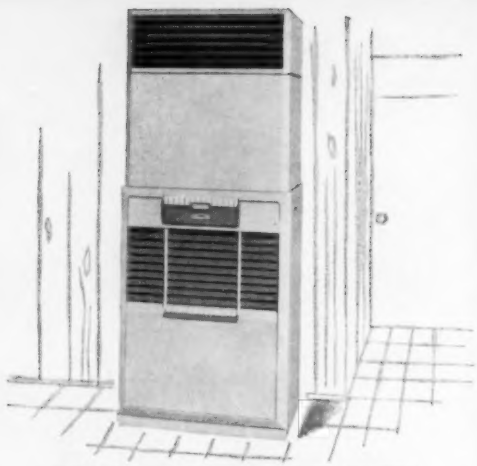
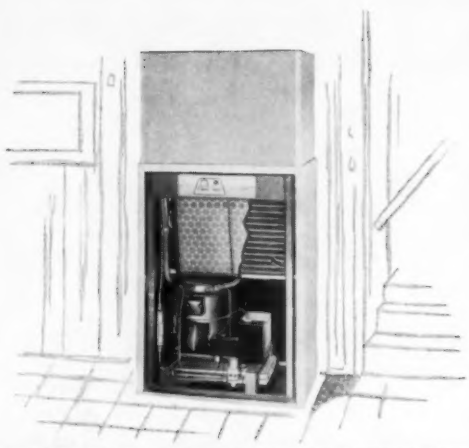
MITCHELL ...YOUR BIGGEST SALES OPPORTUNITY IN PACKAGED AIR CONDITIONERS



COMMERCIAL AIR CONDITIONER

2, 3, 5 & 7½ Ton Air and Water Cooled

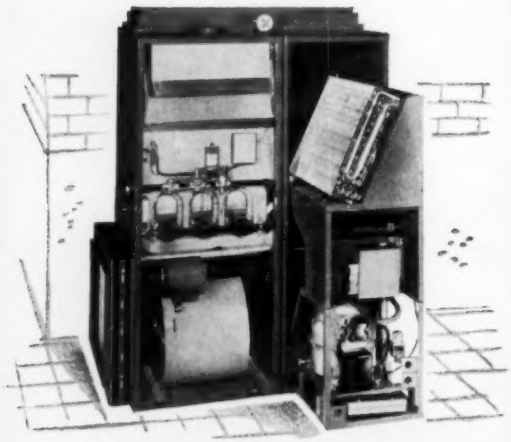
Ideal for commercial and industrial air conditioning. Includes hermetic refrigeration chassis, powerful blower section and air distribution plenum.



RESIDENTIAL ADD-ON AIR CONDITIONER

2, 3 & 5 Ton Air and Water Cooled

Converts present warm air heating system to a year 'round air conditioning system with this powerful Mitchell Add-On unit.



YEAR 'ROUND AIR CONDITIONING

1½, 2 & 3 Ton Air and Water Cooled with Gas Fired Furnaces from 70,000 to 150,000 BTU/hr.

For new construction and the replacement furnace market, these powerful year 'round air conditioners are versatile, compact, easy to install . . . the easiest to service.

It pays to tie-in with MITCHELL the *accepted* name in air conditioning

If you are an experienced Air Conditioning Contractor with an organization that can sell, install and service both commercial and residential air conditioners, Mitchell offers you a fabulous opportunity with a Direct Factory Franchise. *Write today* on your letterhead for complete information and literature.

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In Canada: Mitchell Mfg. Co., 19 Waterman Ave., Toronto, Can.

CHASE copper tube for soil, waste and vent lines at little or no extra cost!

Consider *installation* costs, and you'll see why a Chase quality drainage system will cost little or *no more* than an ordinary system. Actual comparisons *prove* this!

Chase 3" Copper Drainage Tube fits *within* standard partitions, eliminates costly furring-out construction required with ordinary systems.

The *inside* of a Chase Drainage System is also worth talking about—Chase Copper Tube and Solder-Joint Fittings have no internal projections to trap waste—they provide fast, even drainage and make a neater, more compact job all around.

Your Chase Wholesaler has a complete line of Chase Drainage Tube and Fittings. Order them from him for your next job!

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Chase® Copper adds extra value to any home!

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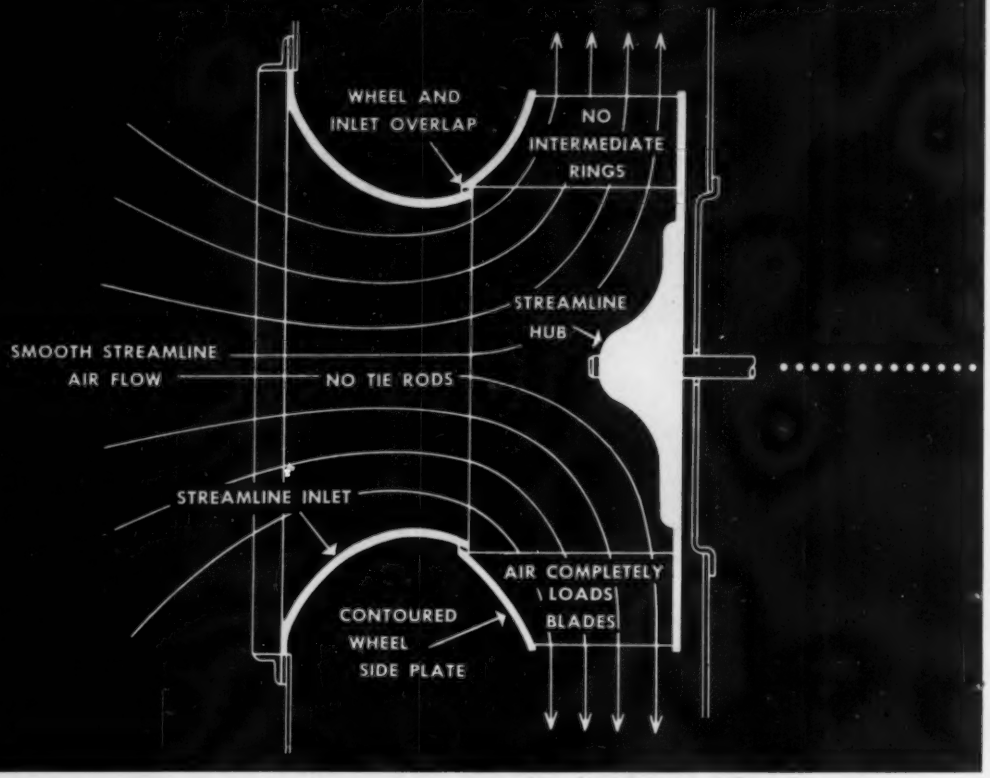
Charlotte†	Denver	Kansas City, Mo.	New Orleans	Rochester†	(†sales office only)

Fact:

Westinghouse Aerodynamic Fan Line More Efficient,



MECHANICAL EFFICIENCY 86%...
STATIC EFFICIENCY OVER 80%

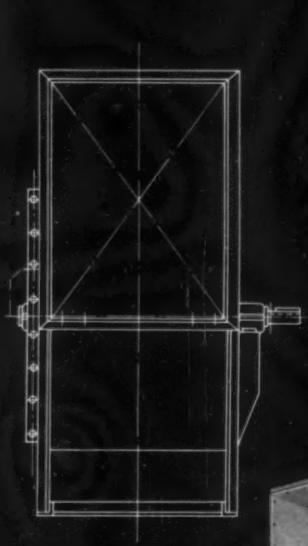
With unobstructed airflow through the wheel in all sizes, the "Silentvane" fan line also offers these other practical advantages:

1. **True self-limiting horsepower characteristic**
2. **Peak horsepower developed in normal selection range**
3. **Quiet, stable operation**
4. **Sharply rising pressure characteristic throughout normal performance range**

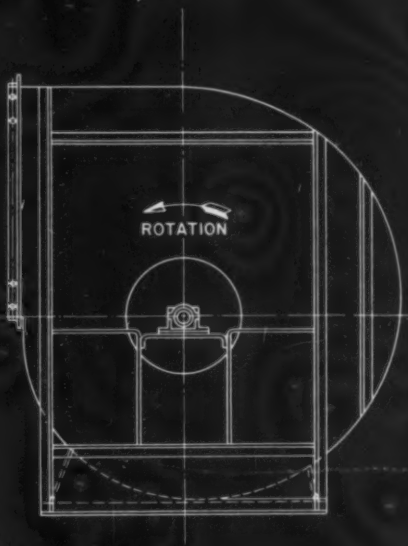
WIDE RANGE OF APPLICATION

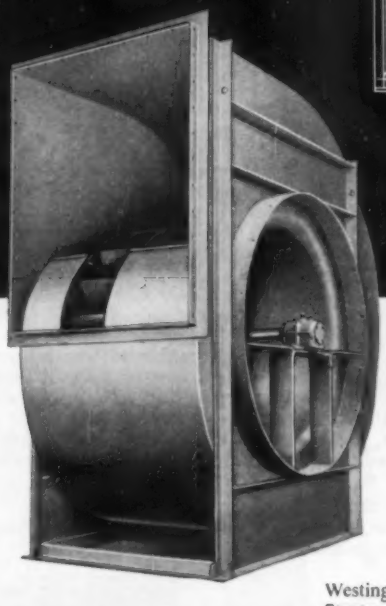
Handling from 600 to 500,000 cfm, the performance-proved Westinghouse "Silentvane" fan line provides an almost unlimited choice of air moving equipment. Coupled with Westinghouse-Sturtevant power-saving Vane Control, "Silentvane" fans offer precise control of air volume at optimum efficiencies. In smaller sizes, 36" and under, fan arrangements are convertible.

Research Makes "Silentvane" Quiet, Non-Overloading



Rugged housing construction and angle iron bracing prevents vibration . . . means quieter operation.





AIRFOIL BLADING AVAILABLE

. . . where quiet operation and power evaluation are prime considerations—
65% less noise intensity . . .
92% mechanical efficiency.

MORE FACTS?

Call your nearest Westinghouse-Sturtevant Sales Engineer . . . he's the "Man with the Facts" on heating, air handling, and electronic air cleaning . . . or fill in the coupon below.

WESTINGHOUSE AIR HANDLING

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East,

South,

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Beautiful, radiant-heated Paramus (N.J.) Memorial School

Modern Lakeview School, Vass, N. Carolina is, naturally radiant heated

Washington-Douglass Elementary School, Jackson, Tenn., modern as its radiant heating

Attractive radiant-heated Rosemead High School, Los Angeles, Calif.

radiant heating does it best!

We may be amused by the overworked expression, "from the rock-bound coast of Maine to the sun-kissed shores of California" . . . but that phrase well describes the sweep of the school-design revolution that is obvious everywhere.

Pride of our land, the magnificent schools are a credit to our national maturity and are receiving more specialized attention than perhaps any other type of building. Common sense, not indulgence, indicates that facilities that protect the health and well-being of students also promote the feeding of their minds.

Thus, among the considerations of lighting, ventilation, sanitation, recreation and heating, *radiant* heating is widely adopted as one of the most healthful. Its gentle, all-permeating, sun-like warmth . . . free from drafts, dust-laden currents and hot or cold spots . . . is ideal. Other advantages include concealed heating sources that thwart vandalism, promote safety, save floor and wall space and improve classroom appearance. Yes, from auditorium to gymnasium, from office to classroom, radiant heating "does it best."

And *steel pipe* also *does it best* as the heat transmission medium . . . proved in more than 60 years of conventional hot water and steam heating applications. In fact, *steel pipe* is the most widely used pipe in the world for heating, plumbing, snow melting, fire sprinkler systems and the transmission of power, steam and air.

Send for free 48 page color booklet "Radiant Panel Heating with Steel Pipe" and 32 page companion booklet "Steel Pipe Snow Melting and Ice Removal Systems."

Typical classroom radiant-heating installation

Steel Pipe is First Choice

Committee on

STEEL PIPE RESEARCH

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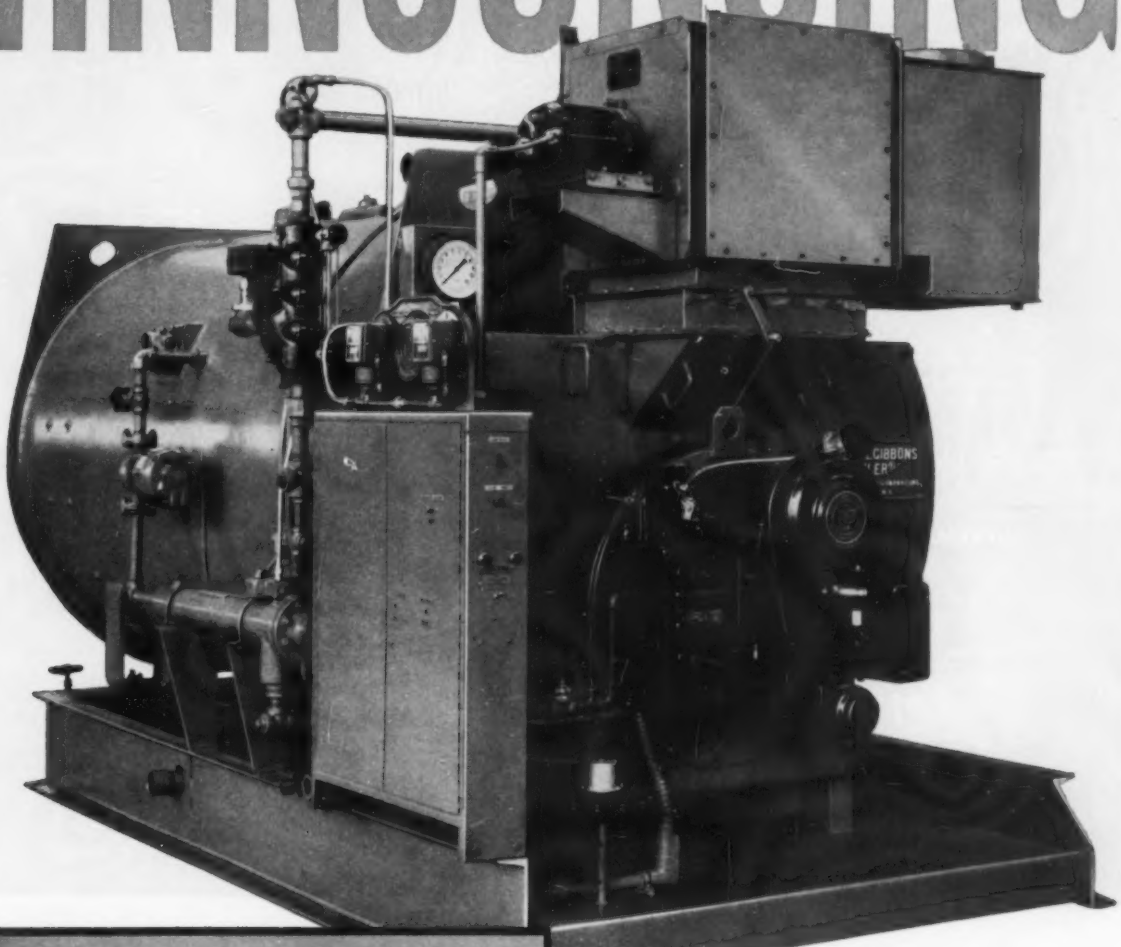
ANNOUNCING

FITZGIBBONS *Packaged* BOILER UNIT



A coordinated, complete low pressure heating package fire-tested and shipped as a unit!

REAR FURNACE WALLS COMPLETELY WATER JACKETED NO REAR WALL REFRACTORY NEEDED

- Induced draft for cleaner, quieter operation.
- Fully automatic for oil, gas or combination.
- 80% efficiency certified at gross output.
- Compact – Minimum clearance only needed at rear and one side.
- Rated on basis of 8.2 sq. ft. heating surface per boiler hp. with guaranteed gross output based on 5.0 sq. ft. heating surface per boiler hp.

Catalog FPB-10 gives complete details.
Address Fitzgibbons Boiler Company, Inc.,
101 Park Avenue, New York 17, N. Y.

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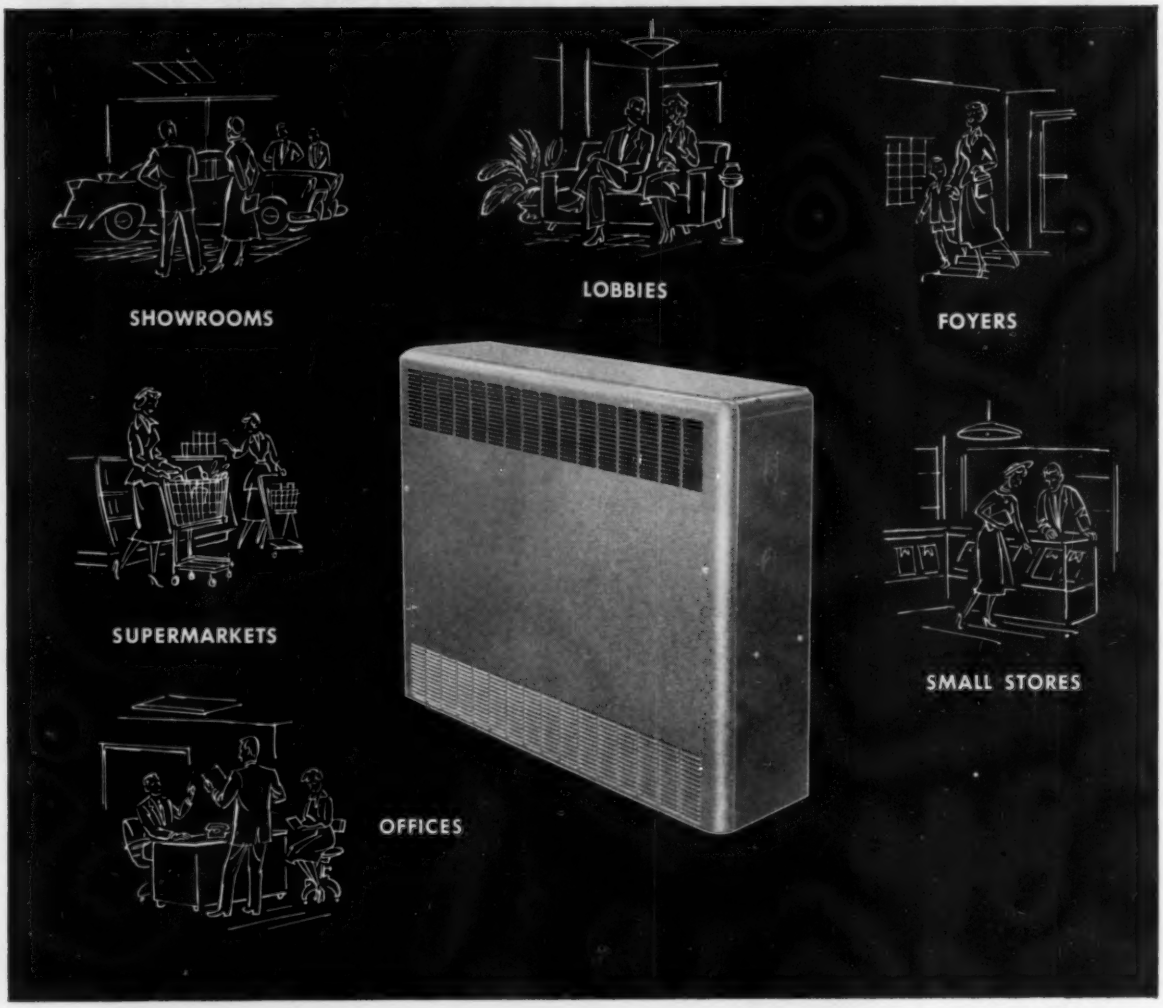
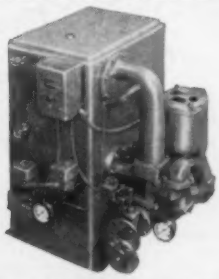
The Fitzgibbons Boiler®

Announcing New DUNHAM Cabinet



From radiator traps
to fully engineered systems
you can DEPEND ON DUNHAM for
everything you need in heating

Dunham Radiator Valves. Complete line of radiator valves, traps and other specialties for steam heating.

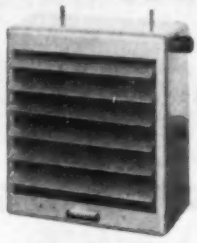


Dunham Vacuum Heating Pumps. Single and Duplex models. No close clearance parts. Only one moving element.

Heaters with the Convector look...

unit heater capacity

Dunham Cabinet Unit Heater, interior view, showing blower fans, nonferrous heating element, removable fan assembly, filter.



Dunham Horizontal Discharge Unit Heater, for steam or hot water, capacities from 10,600 to 360,000 BTU.

Dunham Vertical Discharge Unit Heater, for steam or hot water, capacities from 26,000 to 576,000 BTU.

These new Dunham Cabinet Heaters combine the attractive looks of a convector with the high heating capacity of a unit heater. Moderate in price, they're a sure-fire solution to the problem of heating lobbies, foyers, showrooms, supermarkets, small stores and offices.

Easy to Install in floor-mounted, vertically wall-mounted, recessed or concealed positions. Seven different styles. Keyhole slots punched through back of cabinet assure rapid mounting. Front cover secured by just two screws on most models. Knockouts provided for all connections.

Quiet Operation. Two-speed motor mounted in rubber. Lightweight, balanced blower fan wheels, large heating element area for low air velocities. Replaceable filter.

Less Maintenance. 16-gage steel cabinet fronts—20-gage tops, ends, backs. Blower wheels directly mounted on double-end shaft motor completely eliminates external bearing, pulley and all belt troubles.

For industrial and other large space-heating applications, Dunham offers a complete line of propeller fan unit heaters—both horizontal and vertical types—in a broad range of sizes.

For full information, write for Bulletin HPAC-4, C. A. Dunham Company, 400 W. Madison Street, Chicago 6, Illinois.

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RADIATION • CONTROLS • UNIT HEATERS • PUMPS • SPECIALTIES

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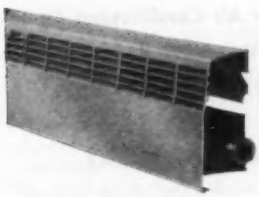
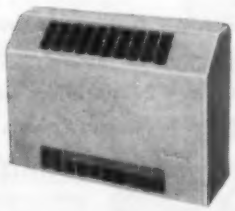
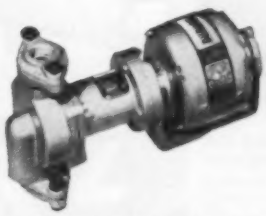


Dunham Radiation. Full range of sizes and types of convectors, baseboard and finned tube radiation.

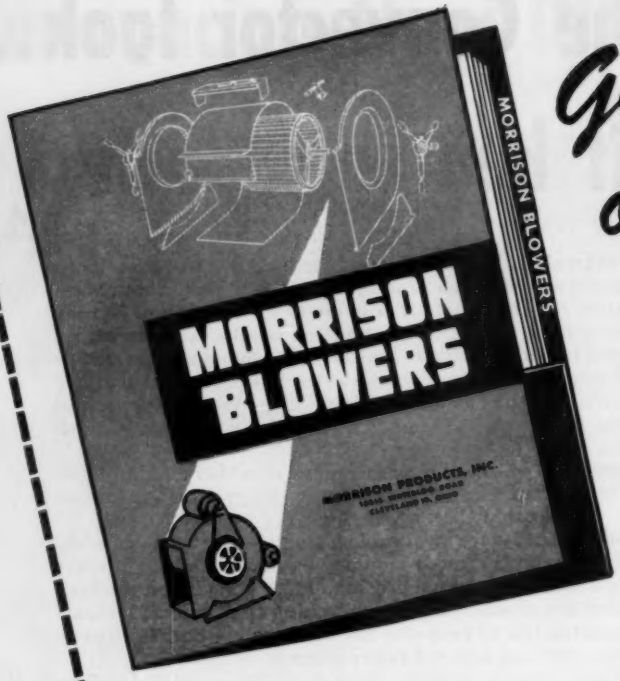


Dunham Unit Heaters. Line includes heating-cooling units, vertical, horizontal discharge and large blower unit heaters.



Dunham Circulators. Heart of Dunham's complete hot water line. Single-spring motor coupling. Brand-name motor.

Dunham Vari-Vac®. Precision temperature control system uses continuous-flow "cool" steam, cuts fuel costs up to 40%.



Get your Copy of the

NEW MORRISON BLOWER

CATALOG NO. 603

Design and development engineers and purchasing agents of original equipment manufacturers, will find this catalog a great convenience. It features a separate catalog sheet for each individual Morrison Blower.

To aid in proper blower selection, performance curves, as well as performance tables are featured.

To aid in layout and design, full dimensional data is given — also pulley size and belt length for the usual range of speeds.

To aid the buyer of parts, an explosion view of blower is shown, with each component part identified.

To aid the buyer of assemblies, illustrations of the various types available, are shown.

FOR ORIGINAL EQUIPMENT MANUFACTURERS OF:

Warm Air Furnaces • Winter Air Conditioning Equipment • Year 'Round A.C. Equipment • Evaporation Coolers • Evaporation Condensers • Air Cooled Condensers • Cooling Towers

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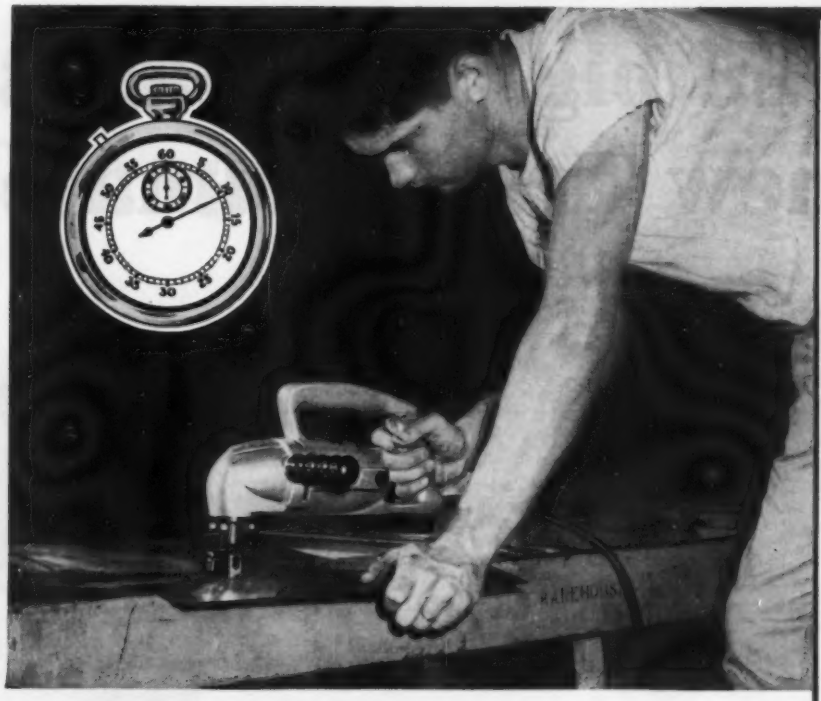


New SKIL Shear Sweeps Field in Actual Comparison Tests!

SKIL Model 231 Wins 5 Trials Out of 5 Outperforms, Outproduces All Others

Actual tests prove what many sheet metal men are learning for themselves. The new SKIL 231 Shear is far superior to all others on the market. These tests show the speed, power, and control that are making the SKIL Shear so popular on every job . . . in every shop.

Here are actual results of impartial tests of the SKIL Model 231 Shear and competitive brands. Shown are performance figures for SKIL, Brand A, and Brand B.

Test 1:

25" Trial Cut of 12 Gauge Metal
Model 231.....9.2 seconds
Brand A.....15.3 seconds
Brand B.....12.0 seconds

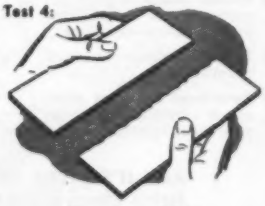
Test 2:

Cutting Right and Left Hand Circles
Model 231.....22.0 seconds
Brand A.....24.0 seconds
Brand B.....22.2 seconds

Test 3:

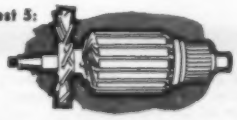
Small Diameter of Circular Cuts
Model 231.....1½"
Brand A.....2"
Brand B.....(right hand) 2½"
(left hand) 4½"

Test 4:



Cleanness of Cuts
Model 231.....Excellent
Brand A.....Good
Brand B.....Poor

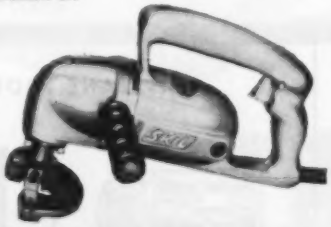
Test 5:



Power and Performance
SKIL 40% more powerful than Brand A and 33⅓% more powerful than Brand B.

SKIL SHEAR 231—Best All-Around

The results show that the 231 is the best all-around Shear on the market today. Faster, easier handling, more powerful! Features like the Contour Grip Handle at the rear of the tool make it a favorite with workmen who have tough cutting to do. Improved foot design keeps maintenance costs down for job superintendents. This is the shear you need in *your* shop. The SKIL Model 231.



FREE! Mail the Coupon for a Demonstration and a FREE Trial of the SKIL SHEAR Model 231! See How Much Faster, Easier-Handling this New SKIL Shear is on your Toughest Cutting Job!

Contact Your SKIL Distributor—or Your Nearby Factory Branch—for Complete Information.

SKIL
PORTABLE TOOLS

Made only by SKIL Corporation, formerly SKILSAW, Inc.
5033 Elston Ave., Chicago 30, Illinois
3601 Dundas Street West, Toronto 9, Ontario
Factory Branches in All Leading Cities

—MAIL THIS COUPON!—

SKIL Corporation, Dept. HPA-45
5033 Elston Avenue, Chicago 30, Illinois

☐ I would like a demonstration and free trial.
☐ Please send literature on SKIL tools.

Name_____
Company_____
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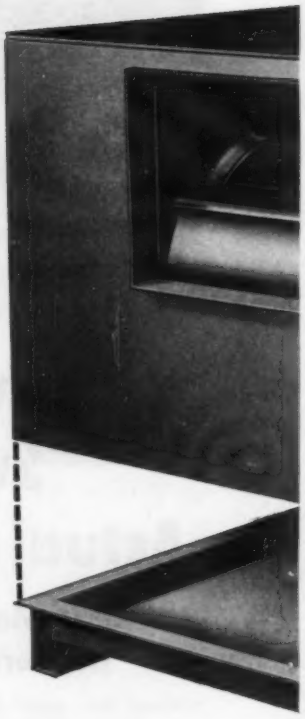
City_____ Zone_____ State_____

16 big advantages ... the new Trane Climate

Meet wider capacity needs, closer space requirements . . . get more features that give you greater flexibility, easier installation!



600 to 29,000 cfm—*with 20 new* TRANE *Climate Changers! This line is so complete it's like having equipment tailor-made to your needs!*

You get *all* the features for complete design flexibility, full accessibility, less maintenance. You get *sectionalized construction* to help you meet close space requirements. (All units clear 36" door except sections of largest unit which clear 40" door.) You get any or all of *24 practical combinations* of heating, cooling, humidification, dehumidification, ventilating, filtering—and in the *exact degree* you demand! You get *the one line that's unmatched anywhere, in any way, for versatility!*

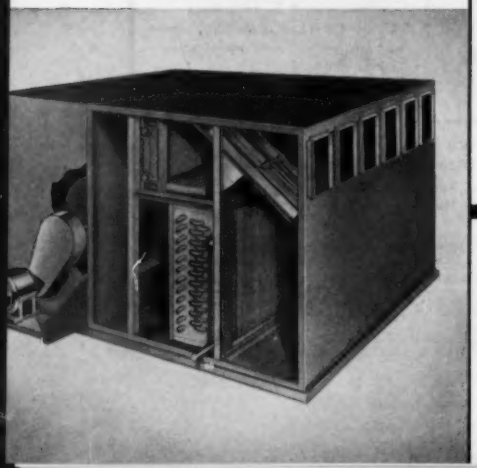
Want more facts? See your nearby TRANE Sales Office or write TRANE, La Crosse, Wis.

EVERY FEATURE TO MAKE *YOUR* JOB EASIER!

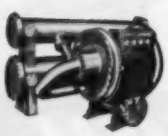
1. **Rotatable fan discharge** for greater design flexibility.
2. **Laboratory rated fan** is rated *in the unit* to assure *guaranteed performance.*
3. **Adjustable motor mounting** permits standard motors to be used on all units.
4. **Welded construction** of fan section adds rigidity for long, efficient operation.
5. **External bearings** for easier maintenance.
6. **Extra-large fan shaft** minimizes vibration, helps assure quiet operation.
7. **Choice of humidifiers**—water spray, steam pan or steam grid types.
8. **Sloping drain pan** under entire unit assures positive drainage.
9. **Side drain connection** saves head room.
10. **Choice of casings** — horizontal or vertical, to fit the physical requirements of the job. (Horizontal model illustrated)
11. **Choice of heating coils**—steam or hot water; three types.
12. **Choice of cooling coils**—water or D.E.; five types.
13. **Exclusive Delta Flo Fin** coil has greater heat transfer efficiency, added strength.
14. **Face and by-pass dampers** with external by-pass for modulating control.
15. **Choice of filter boxes**—high or low velocity; permanent or throwaway-type filters.
16. **Optional mixing box** designed with filter frame eliminates need for separate filter section.

AND IT'S EXTRA QUIET! *Every fan designed especially for its unit for highest efficiency, quietest operation. Low outlet velocities (approximately 1,500 fpm at 500 fpm coil face velocity), extra large, solid steel shafts and rugged welded construction combine to assure quietness that lasts!*

Multi-Zone Climate Changers provide a number of zones with different climates at the same time.



A TRANE PRODUCT FOR EVERY AIR CONDITIONING

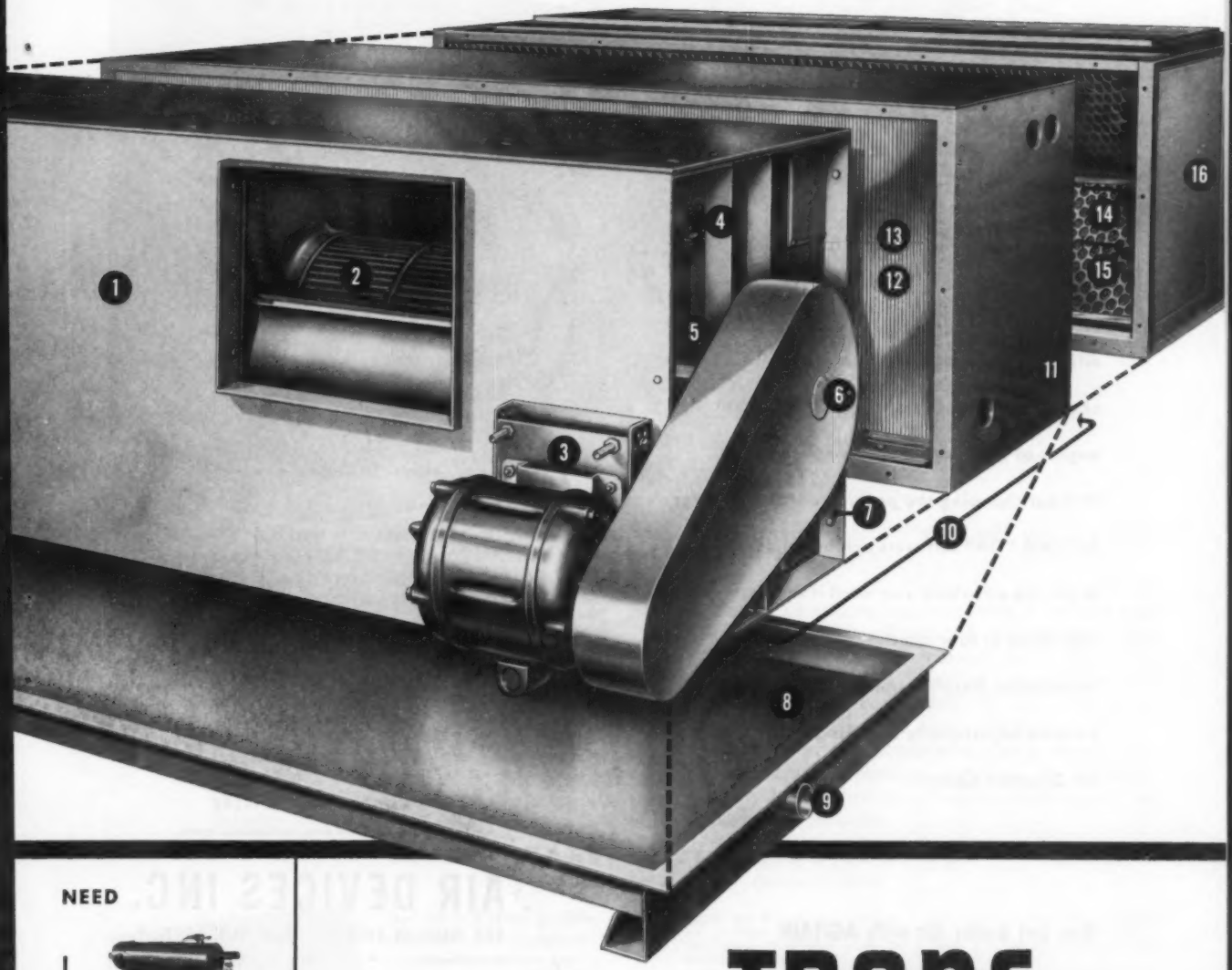


CenTraVac centrifugal water chillers, 45 to 400 ton capacity.

Self-Contained air conditioners from 3 to 20 tons capacity.

UniTrane room units for air conditioning multi-room buildings.

in one air conditioner
Changer



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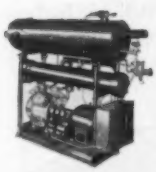


Cold Generator factory-assembled water chillers, 10 to 100 tons.

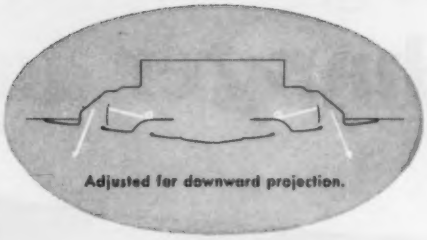
TRANE

MANUFACTURING ENGINEERS

One source, one responsibility for: Air Conditioning • Heating • Ventilating • Heat Transfer Equipment

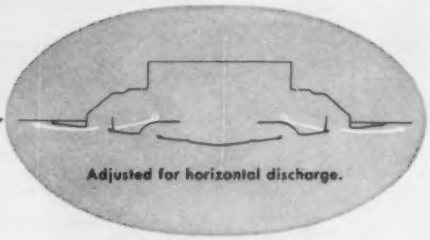
The Trane Company, La Crosse, Wis. • Eastern Mfg. Div., Scranton, Pa. • Trane Co. of Canada, Ltd., Toronto
• 90 U.S. and 17 Canadian Offices

Take a look at a TRULY ADJUSTABLE Diffuser

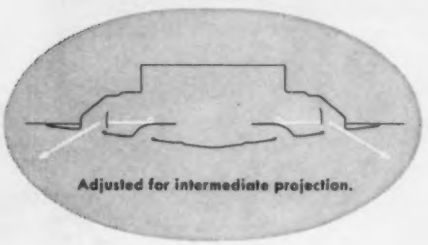


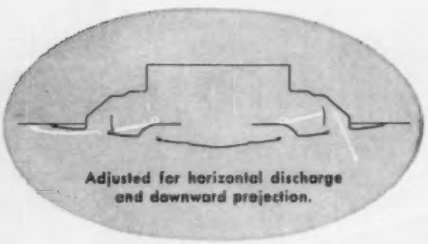
AGITAIR®

TYPE "OA"



Here's a distinctively different diffuser with a radically new means of controlling air direction at four different angles of discharge simultaneously. *Without changing the position of the spinnings,* AGITAIR "OA" diffusers can be adjusted to put the air where you want it in one, two, three or four directions . . . *after installation.* Result: Segmentized . . . positive adjustability with Finger-Tip Air Direction Control.





Write for Bulletin C-101

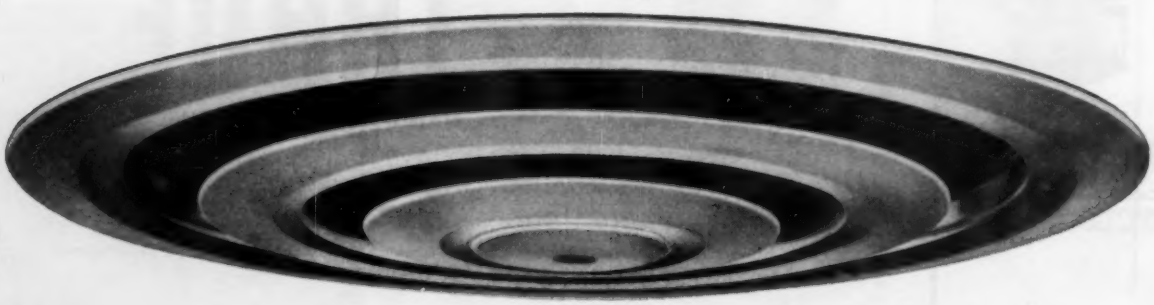
Contains complete data, performance charts, construction details, etc.

AIR DEVICES INC.

185 MADISON AVENUE NEW YORK 16, N. Y.

Air Diffusers • Filters • Exhausters

You Get Better Air with AGITAIR



Now—CORROSION PROTECTION at a BUDGET PRICE

● Here is a deaerator of Schaub quality, engineered on new principles, designed especially to put effective boiler feed water deaeration within price reach of the small to medium size plant.

These plants, from 3,000 to 30,000 lbs/hr., often running at low pressure, are likely to have the same corrosion and high maintenance costs as their "big brothers". In fact, "Return Line Corrosion" is *most apt* to occur in *low pressure* heating systems even though raw water make up is negligible. For such plants, as well as for high pressure installations, the Schaub .03 Deaerator offers an effective and economical solution that will pay for itself many times over.

The Schaub .03 Deaerator operates *fully vented* at atmospheric pressure. Premium cost construction is eliminated, maintenance and operating costs are reduced to a minimum. Liberated, non-condensible gases escape *immediately* and *completely*. At the same time, simple but effective spray-contact vent condensing, prevents wasteful steam vapor loss. Pin-point temperature control, "live-action" heating and rust-proof chromasoid lining are exclusive features.

FRED H. SCHAUB ENGINEERING COMPANY
2116 South Marshall Boulevard • Chicago 23, Illinois

Get the Full Story on This More Efficient Low Cost Deaerator — Write for Bulletin 1300

Simple though it is, there's much more to the Schaub .03 Deaerator than can be told here. Bulletin 1300 is filled with information for the operating or consulting engineer responsible for economical and efficient deaeration of boiler feedwater. Tells the "hows" and "whys" of deaeration, especially for the small to medium size plant, explains how the Schaub method differs and its advantages in performance and low cost. Mail the coupon today.

NOTE: The Schaub .03 Deaerator is designed for boilers up to 30,000 lbs. per hour. For capacities up to 100,000 lbs. per hour at .005 cc/liter "zero-oxygen" removal write for Bulletin 575, describing the Schaub Zero-Oxygen Deaerator.

FRED H. SCHAUB ENGINEERING COMPANY
2116 South Marshall Blvd., Chicago 23, Illinois

Please send me, without cost or obligation, my personal copy of your new Bulletin 1300 on Boiler Feedwater Deaeration.

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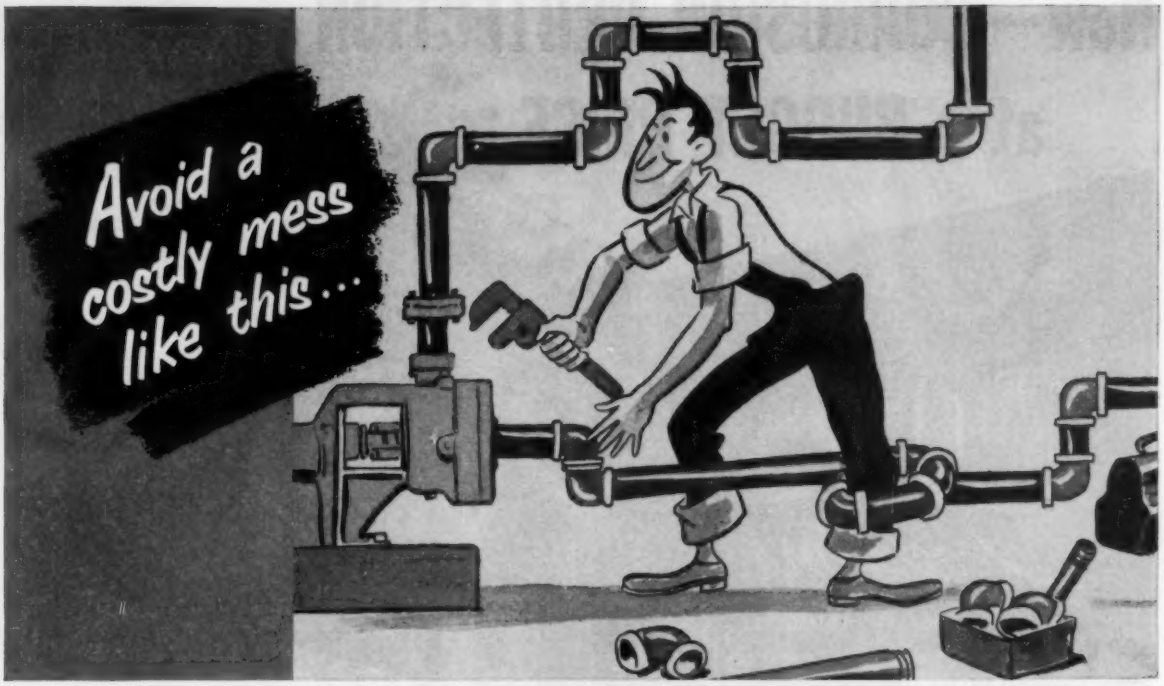
COMPANY.....

ADDRESS.....

CITY.....ZONE....STATE.....



Get Allis-Chalmers Engineering help on PUMPS

It pays to rely on Allis-Chalmers for your air conditioning pump needs. Your Allis-Chalmers representative or distributor is an experienced, highly qualified specialist who will help you pre-engineer the setup — help you get the simplest possible layout that will be most effective.

Get Immediate Delivery From Stock

Allis-Chalmers air conditioning pumps, in a complete range of types and sizes, are carried in stock by Regional Warehouses and Authorized Distributors throughout the country. Your representative will show you how to expedite pump selection and ordering. Contact him before you start your next job. A-4623

Milwaukee 1, Wisconsin

ALLIS-CHALMERS

New Prudential Building to burn coal the modern way

Ultra-modern in all respects, the new 41-story building of the Prudential Insurance Company of America in Chicago incorporates the latest developments in design, fixtures and construction. This beautiful structure will be completely air-conditioned and will offer its occupants all possible conveniences.

Among those conveniences will be Prudential's heating system, as up-to-date as the building itself. This most modern building in the country will burn *coal*. Cleanly. Efficiently. And its completely automatic coal handling and burning installation will provide sure, even heat *economically* under all conditions.

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Why not talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars each year.

facts you should know about coal

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems result in a virtually labor-free plant.

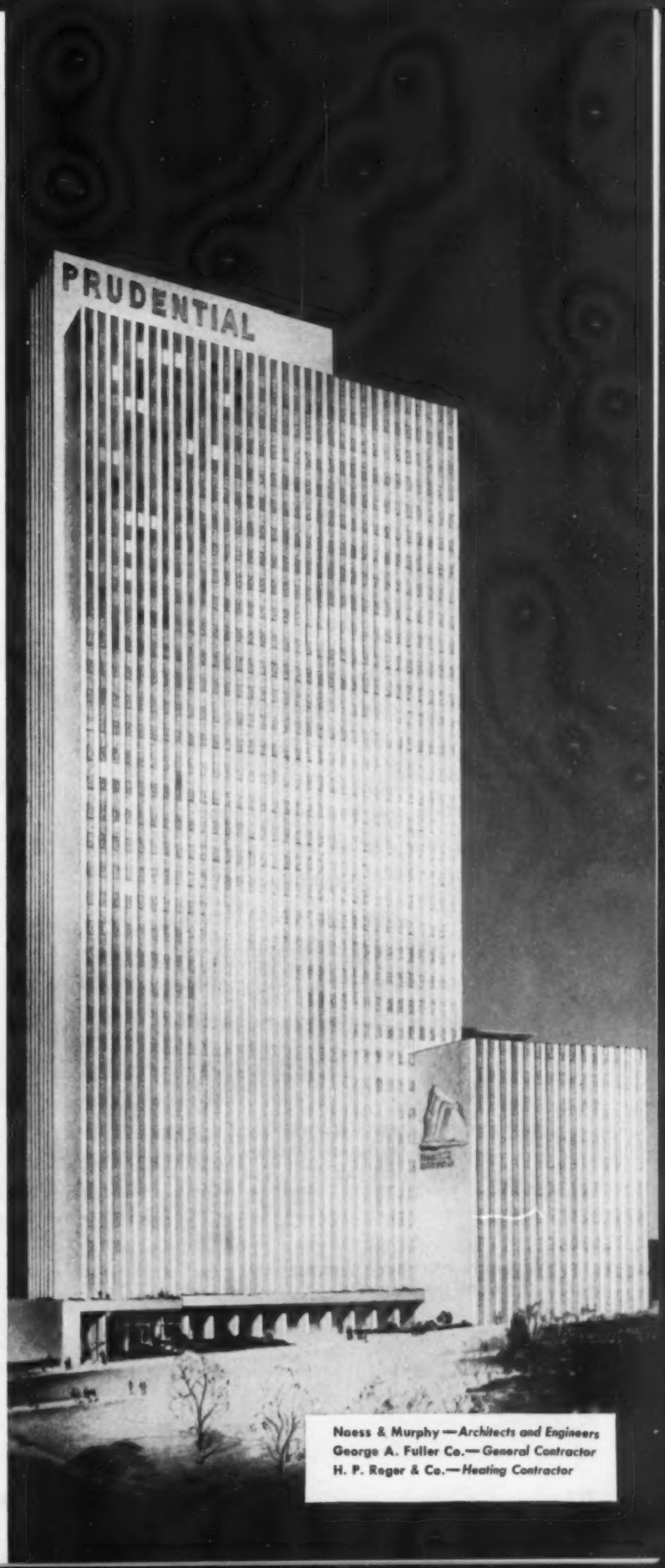
Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.



Naess & Murphy—*Architects and Engineers*
George A. Fuller Co.—*General Contractor*
H. P. Reger & Co.—*Heating Contractor*

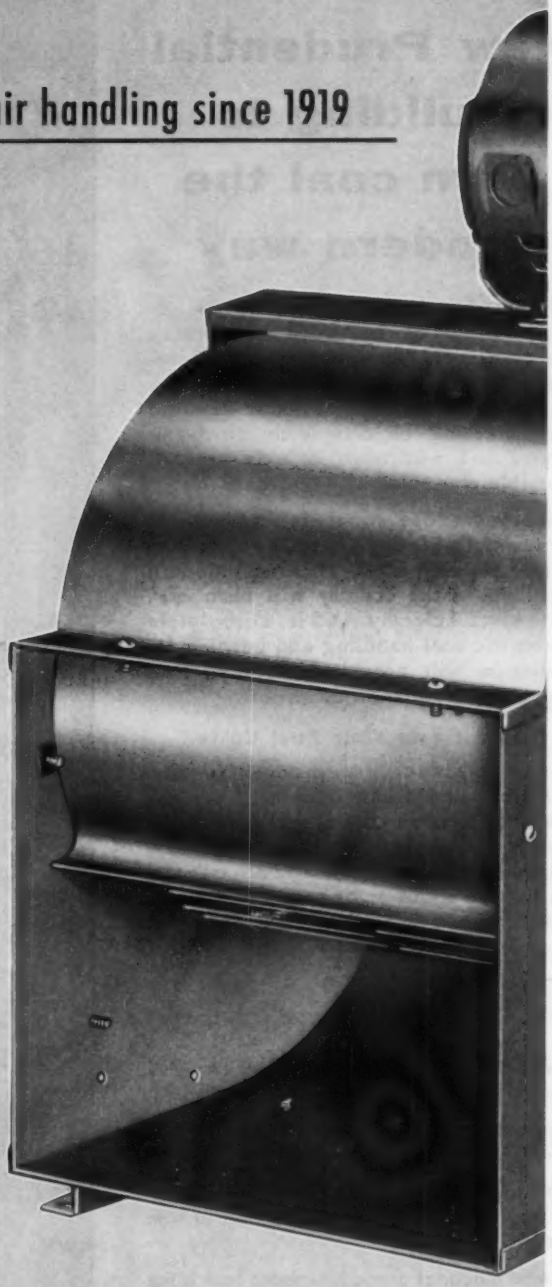
Brundage ...for better air handling since 1919

Quiet Please...

Quiet is the word for Brundage Blowers — and the key to happy customers who don't even want to know they have a blower.

Add the practically service-free performance of extra-strong construction and you have a sure hit with your dealers too.

Whether you manufacture heating or cooling equipment, you can be sure of the quality to match your finest product when you choose Brundage . . . quality proven since 1919.



ASK FOR SAMPLE BLOWERS TO PROVE BRUNDAGE VALUE IN YOUR OWN LAB.

RELIABLE SERVICE — WHEN YOU NEED IT!

WRITE FOR FREE LITERATURE PRICES ON REQUEST

THE Brundage COMPANY

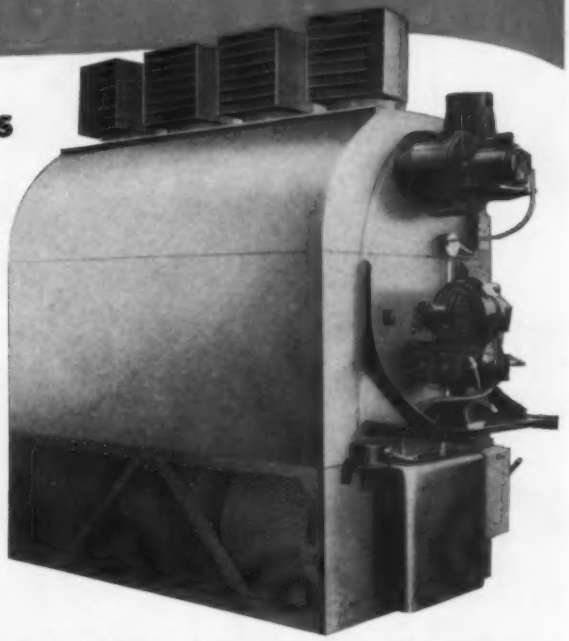
512 N. PARK STREET • KALAMAZOO, MICH.

Phone 2-0251

INTRODUCING THE VERSATILE

Commercial-Aire

DIRECT-FIRED SPACE HEATERS



A Modern Concept of

- Combustion Efficiency
- Air Engineering
- Control System Design
- Warm Air Versatility

SENSIBLY PRICED

EFFICIENT — Commercial-Aire direct-fired heaters offer a new high in efficiency. Recommended for the proper heating of industrial, commercial and warehouse space. These heaters have a guaranteed combustion efficiency of 80%. Newly designed heat exchanger saves fuel. Oversize primary and secondary transfer surfaces stop heat losses. Separate induction draft blower purges combustion chamber. Delayed relay starts main burner only when heat exchanger is purged. Fan control starts main blower only when proper bonnet temperature is reached.

ECONOMICAL — Commercial-Aire direct-fired heaters burn fuel only when thermostats call for heat . . . no heat waste. Burners shut off when desired temperature is reached . . . no heat transmission loss. No fuel burned to maintain steam pressure or water temperature . . . no cold blast on start. High speed heat discharge maintains proper temperature at working level.

ADAPTABLE — Commercial-Aire direct-fired heaters offer a new high in adaptability . . . burn three types of fuel: heavy oil, light oil, gas, and combination of these fuels. Units are of versatile construction and may be installed in any position, upright, horizontally suspended, and inverted suspended. They are adaptable to direct space heating systems or duct distributing systems. 10 Sizes . . . 300,000 to 2,000,000 B.T.U.'s. Write for complete specifications and prices.

Commercial-Aire SPACE HEATERS ARE MADE BY THE MAKERS OF

Send Coupon Today!

MAMMOTH

VERTICAL STEEL TUBULAR HEATERS

Compacto and Adapto models have been long and favorably known. Widely used in churches, schools, factories, auditoriums and commercial buildings where duct type system of heating is indicated. High efficiency comfort heating, with low fuel consumption guaranteed. Write

MAMMOTH FURNACE COMPANY
507 Vandalia Street, St. Paul, Minnesota

Gentlemen:
Please send promptly full information, prices, etc. on

☐ COMMERCIAL-AIRE DIRECT-FIRED SPACE HEATERS
☐ MAMMOTH VERTICAL TUBULAR STEEL FURNACES

Your Name_____

Firm Name_____

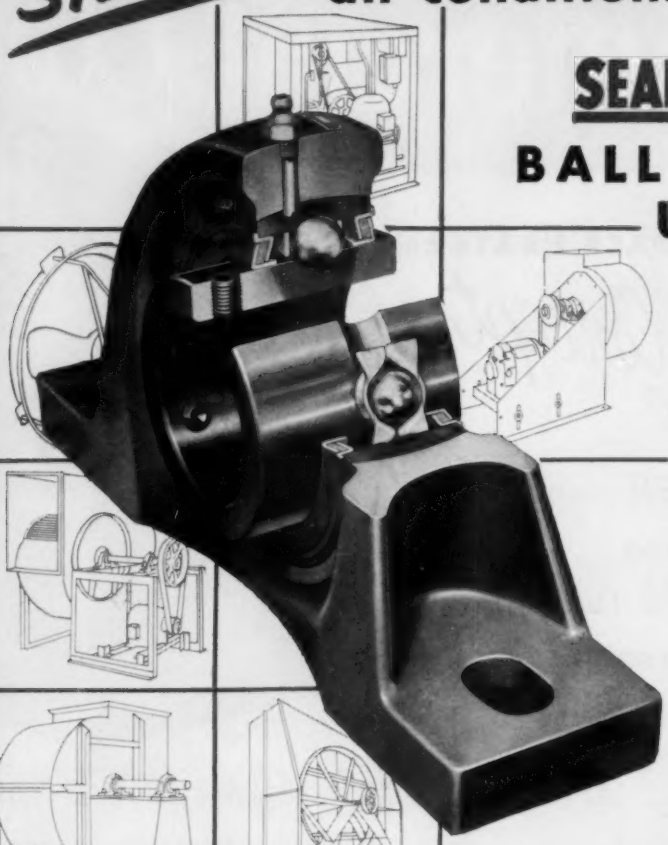
Address_____

City_____ Zone____ State_____

SEALMASTER
BALL BEARING UNITS FOR OUTSTANDING PERFORMANCE!

SILENT partner of the air conditioning industry

SEALMASTER
BALL BEARING UNITS



QUIET, efficient "round the clock" performance for your products!

You can build added sales power today and count on repeat sales tomorrow when your products feature SEALMASTER Ball Bearing Units. **Quiet,** efficient "round the clock" performance is assured with SEALMASTER Bearings and their exclusive combination of features.

Zone hardening, floating ball retainer, locking pin and perimeter dimple and labyrinth seal are important to bearing performance and to the performance of any product using ball bearing units. You will want further information—write TODAY!

Factory Representatives and Dealers Located in All Principal Cities.

Write for your copy of SEALMASTER Catalog 454

SEALMASTER BEARINGS A DIVISION OF STEPHENS-ADAMSON MFG. CO. • 47 RIDGEWAY AVE., AURORA, ILLINOIS

Which is
the best way
to air condition a
SHOPPING CENTER?

Acme Supermarket in Shoppingtown, DeWitt, N. Y., features a modern, year-round Carrier air conditioning system. Peripheral ducts carry cooled air from a 30-ton Weathermaker, warm air from two gas-fired duct-type unit heaters.

The Addis Company is an exclusive specialty shop in this new shopping center. It has its own 40-ton Carrier system complete with an evaporative condenser for 95% water saving, and gas-fired unit heaters for economical winter heating.

Candlelight Shop, Shoppingtown's gift center, packs a self-contained Carrier Weathermaker® into a side wall. The unit taps into ductwork previously installed for warm air furnace. New air-cooled Weathermakers require no water.

Carrier is the quickest way to the right answer

JUST 1–2 AND THE JOB IS THROUGH!

Carrier has all the ways to control the temperature on any job, summer or winter—and all Carrier equipment is engineered to the same uniform standard. So short-cut hours of selection by (1) using the Carrier line as your shopping guide and then (2) comparing values. Get in touch with your Carrier dealer or distributor—listed in the Classified Telephone Directory. Or write to us directly. Carrier Corporation, Syracuse, New York.

*Reg. U.S. Pat. Off.

Carrier

air conditioning · refrigeration · industrial heating

KENNARD *Engineered*

KT WATER SAVERS

with CENTRIFUGAL TYPE FAN for quiet Indoor Operation

KENNARD KT Water Savers—Engineered for Long Life.

Compare these outstanding features. Centrifugal fan, Redwood wetted deck, Galvanized construction throughout—Brass and Bronze trim.

Compact, quiet—place it in your home. Efficient, rugged—for outdoor commercial use. *In stock—order yours now!*

INDOOR or OUTDOOR, sized to meet your requirements. 3, 5, 8, 11 and 16 ton capacities. Contact your Kennard Agent. Ask for **Catalog KT-2.**

For larger applications—Kennard Cooling Towers, capacities of 20 through 75 tons—ask for **Catalog CT-1.**

for use with ALL MAKES of WATER COOLED Air Conditioners

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Mo., Kansas City	Engineered Equipment Co.
St. Louis	R. H. Spangler & Co., Inc.
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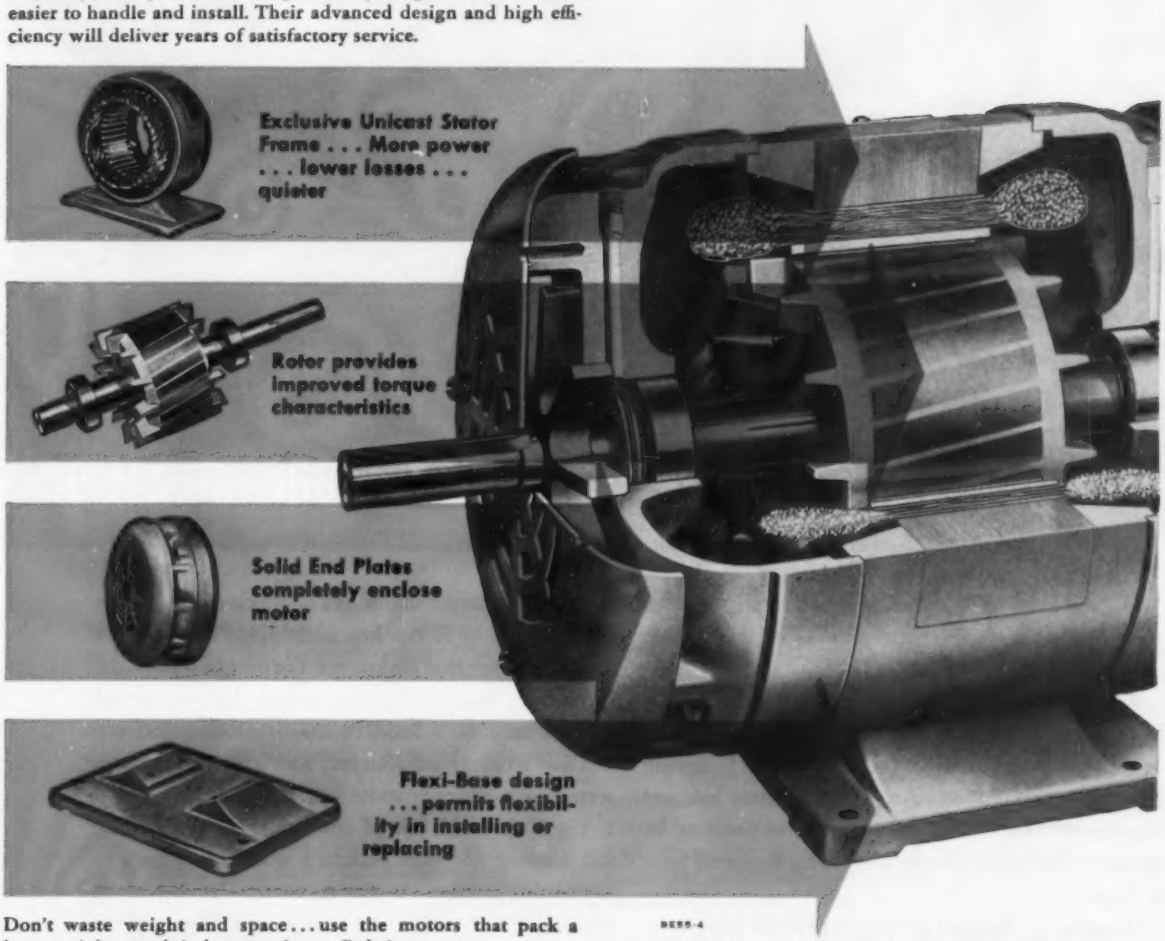
KENNARD CORPORATION
1817 HANLEY RD. • ST. LOUIS 17, MO.

BALTRIC

the motor that doesn't waste an ounce or an inch

The *Streamcooled Baltric* line of totally enclosed motors is *new* and *better*... because it is more compact, more efficient, lighter. Using modern materials and knowledge ... improvements that boost efficiency and trim poundage ... new insulation ... permitting us to build compact power packages that do more work for their size and weight than outdated models of similar ratings.

These powerful, rugged new *Streamcooled Baltric* Motors will do a better job for you. Their compact size and lightness make them easier to handle and install. Their advanced design and high efficiency will deliver years of satisfactory service.


Exclusive Unicast Stator Frame ... More power ... lower losses ... quieter
Rotor provides improved torque characteristics
Solid End Plates completely enclose motor
Flexi-Base design ... permits flexibility in installing or replacing

Don't waste weight and space... use the motors that pack a heavyweight punch in bantam size... *Baltric.*

8555-4

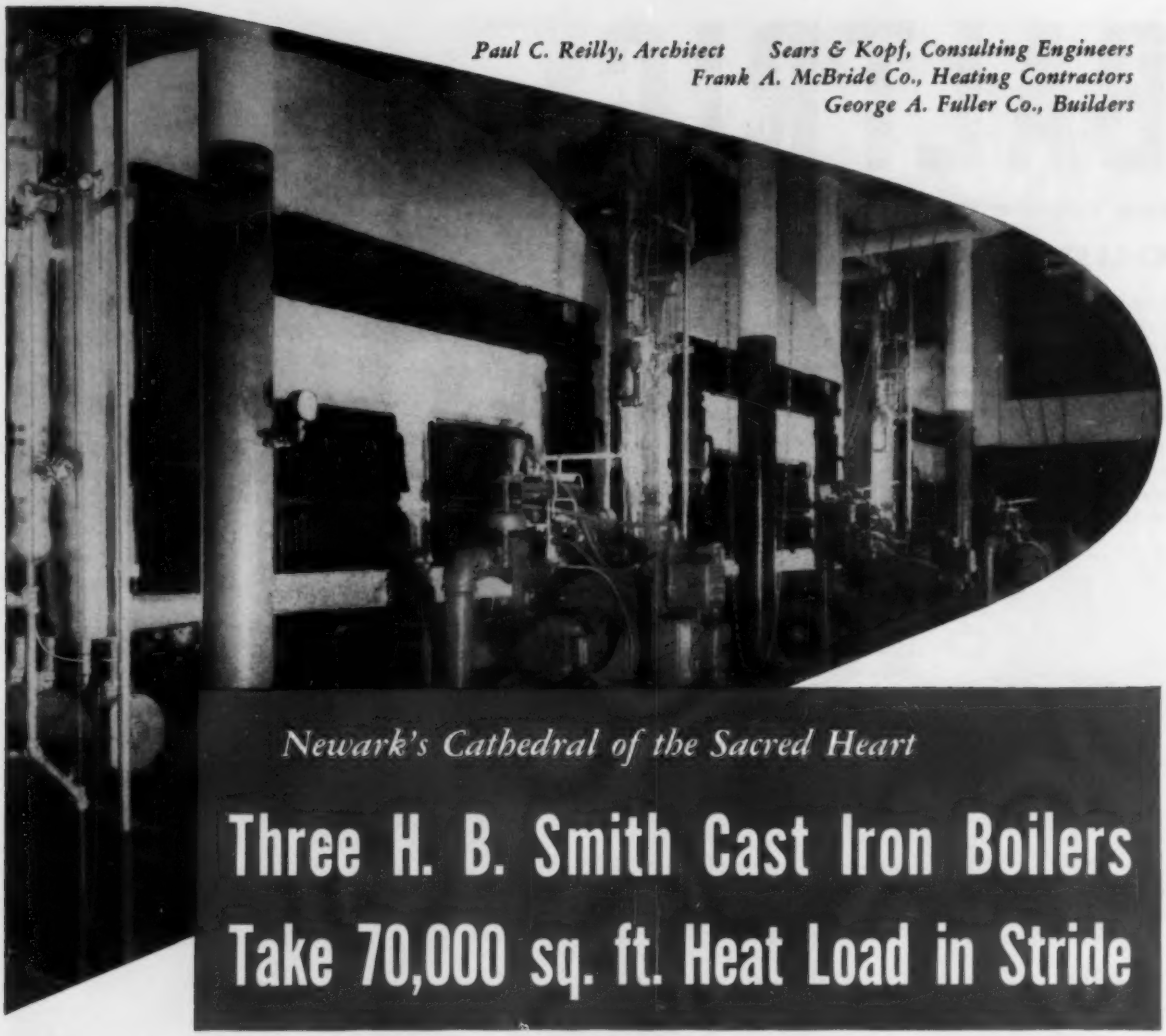
Original *Streamcooled* Motors Also Available — Built to Former NEMA Standards

ALL *BALTRIC* MOTORS TOTALLY ENCLOSED AND *STREAMCOOLED*

BALDOR ELECTRIC COMPANY

Baltric Motors Are Available in Polyphase • Squirrel Cage • Induction and Single Phase • Capacitor Start • Induction Run Types

4353 DUNCAN AVENUE • ST. LOUIS 10, MISSOURI



Paul C. Reilly, Architect *Sears & Kopf, Consulting Engineers*
Frank A. McBride Co., Heating Contractors
George A. Fuller Co., Builders

Newark's Cathedral of the Sacred Heart

Three H. B. Smith Cast Iron Boilers Take 70,000 sq. ft. Heat Load in Stride

The construction of The Cathedral, which started more than fifty years ago, posed a problem of heating and ventilating.

Requiring consideration were the great height of the nave and the large lateral occupied area which in addition to other spaces, totaled 70,000 square feet E. D. R. heating load. To supply the necessary heat and assure balanced distribution called for a high degree of engineering ingenuity — brilliantly met by Consulting Engineers Sears & Kopf.

Assigned to the task of heat generation were three H. B. Smith No. 60 Boilers — the largest three-boiler installation since the Company's founding in 1853. Each boiler consists of 30 cast iron sections, and each boiler is fired with power type gas burners. The over-all result is the comfortable heating of the huge interior. And, as is typical with the use of H. B. Smith Boilers, outstanding efficiency and fuel economy are achieved, with stack temperatures remaining consistently under 400°.

The H. B. Smith line of cast iron boilers for heating and domestic hot water permits a technical approach to any heating problem you may encounter. Broadest in the world, this line contains the concise, specific answer for small homes or multiple-unit applications.

H.B. Smith CAST IRON BOILERS
THE H. B. SMITH COMPANY, INC., WESTFIELD, MASSACHUSETTS
Established 1853

they never get tired!

• YARWAY Single-end Welding-type Gun-Pakt joint for 150 lbs. pressure.

• Some of the 189 YARWAY Gun-Pakt expansion joints installed at large oil refinery in Texas.

No fatigue with 189 YARWAY GUN-PAKT EXPANSION JOINTS at this large Texas refinery

THEY just work and work for years and never get tired. Yarway Gun-Pakt slip-type joints simply will not fail through fatigue. They will operate smoothly, as frequently as required, over long, full traverse up to 12" single type or 24" double type or short, partial traverse, day in and day out—with never any danger of metal fatigue or failure.

This is just one of the many big advantages found in Yarway Gun-Pakt expansion joints. Other outstanding Gun-Pakt features are:

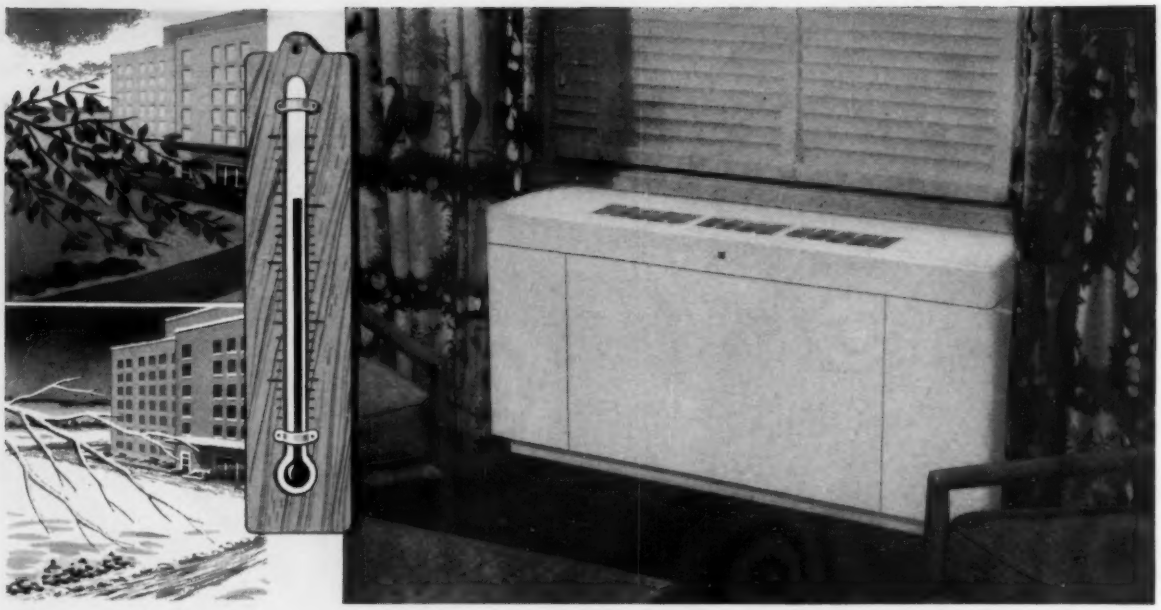
1. Can be serviced under *full* steam pressure day and night, thus avoiding costly and inconvenient shutdowns.
2. Fixed Gun-Pakt gland serves as "built in" external guide and permits less costly and rigid pipe guidance than required by many other types of joints.
3. Lower pressure load on end anchors because excessive strains are eliminated.

Used for many years with success in well-known refineries, industrial plants, utilities and institutions. When replacing present joints or planning new steam lines, it will pay you to look into the advantages of the Yarway Gun-Pakt expansion joint. Write for Yarway Bulletin EJ-1913.

YARNALL-WARING COMPANY
107 Mermaid Avenue, Phila. 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

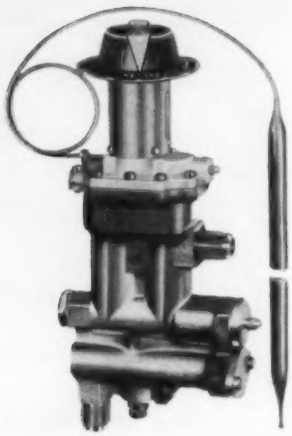
YARWAY

gun-pakt expansion joints



NOW . . . AMERICAN-STANDARD REMOTAIRE HEATING-COOLING UNITS

are available with an automatic control that holds room temperature steady both summer and winter



Individual Remotaire Room Conditioners equipped with the new Selectaflow Control maintain *even* room temperatures all year 'round. The completely self-contained control changes over from summer to winter automatically . . . manual adjustments are not necessary.

The Selectaflow Control maintains even room temperatures by modulating the flow of either hot or cold water through the Remotaire Room Conditioner coils. Since the Remotaire unit's fan operates continually, the heating and cooling operation is smooth and even.

The Selectaflow is a mechanical control—requires no electrical connections—so installation is quick and easy. It can be installed in any Remotaire Room Conditioner. However, if exact temperature control is not essential in every room of the building, it can be installed in critical areas only.

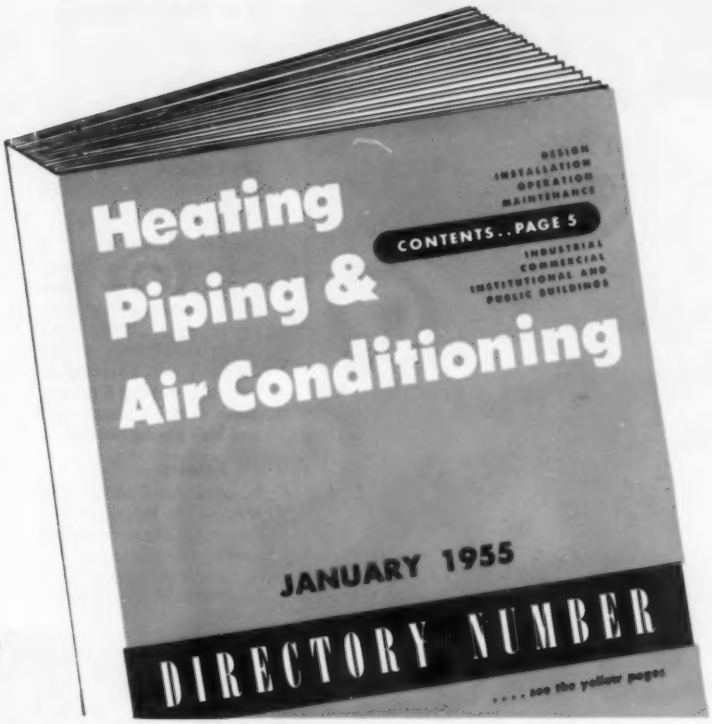
For more information about the complete central plant Remotaire Heating-Cooling System, and the new Selectaflow Control, see your American-Standard sales office or write to **American Radiator & Standard Sanitary Corporation,** P. O. Box 1226, Pittsburgh 30, Pennsylvania.

AMERICAN-STANDARD PRODUCTS

AMERICAN-Standard

WATER HEATING - COOLING SYSTEMS

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS



★ PRODUCTS ADVERTISED

★ PRODUCTS CLASSIFIED

★ TRADE NAMES

★ MANUFACTURERS' ADDRESSES

HERE IS YOUR SOURCE

of Complete Product Information

. . . Are You Finding It Useful?

If you are like the average subscriber, you will have near at hand—and frequently use—this January Directory Number of HPAC . . . . the field's complete reference guide to the products which engineers and contractors specify and purchase for the heating, piping and air conditioning work they handle.

Each January you get a new, up-to-date HP&AC Directory Edition. It's a part of your annual subscription to our publication.

Have you any suggestions for making these editions *more* valuable? . . . . suggestions which we as publishers might adopt, or which we can pass along to the many manufacturers who co-operate with us by furnishing complete data on their products in each January Edition?

Your comments are sincerely welcomed.

Over 90% of those HP&AC subscribers, answering a survey, stated that they found the January Directory Edition helpful in their work.

FIRST *in Editorial . . . in Circulation . . . in Advertising*

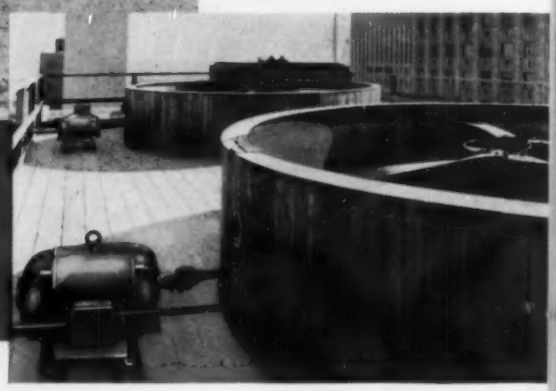
ROBBINS & MYERS AIR CONDITIONING MOTORS

For Cooling Towers
All R & M Air Conditioning Motors are completely "weatherized" for outdoor applications. Here is the one motor you can install and forget.

For Compressors
Patented R & M electronic speed-torque tester shows the *complete* acceleration curve of every R & M motor as it comes off the assembly line, enabling us to design out the dips that make a motor "hang up" and stall during starting.

For Blowers
R & M Air Conditioning Motors are balanced to a far greater degree than normal industry standards; won't transmit annoying vibration through metal ducts.

Robbins & Myers Has Done Something About the Weather!



When it comes to applications involving moisture—and lots of it—most motors just can't stand the gaff. And outdoor applications, like cooling towers, really put a motor to the test.

That's why you'll be interested to know about the unusual R & M "weatherized" Air Conditioning Motor. It's the one motor that's truly conditioned for air conditioning service—*at no extra cost to you.* Install it anywhere—even outdoors without a cover—and you'll see what this remarkable weatherizing process can mean in dependable, economical operation.

And there are other features—usually extra-cost optionals in most motors—that R & M brings you at standard motor prices. Extra-large prelubricated ball bearings . . . full-height end-heads with debris-proof screened openings . . . end-to-end clean-sweep ventilation.

These are just some of the things that give you the extra margin of dependability that air conditioning applications demand. Inside and out, R & M motors are engineered for every air conditioning job.

To get all the facts about the finest air conditioning motor your money can buy, write for a free copy of our Air Conditioning Motor Bulletin HP.

1 to 125 HP . . . Weatherized Inside and Out

Steel parts undercoated.

Rotor assembly rust-inhibited.

Cast-iron parts given special anti-corrosion treatment.

Terminal box gasketed, leads sealed at shell.

All standard R & M 220/440-volt motors easily reconnected on the job for 220-volt part winding starting.

ROBBINS & MYERS, INC.

MOTOR DIVISION: SPRINGFIELD, OHIO • BRANTFORD, ONTARIO

Fractional & Integral h.p. Motors & Generators

Moyno Pumps

Propellair Industrial Ventilating Equipment

Electric Fans

Electric & Hand Hoists & Cranes

Now every room and office can be comfortable

Iron Fireman SelecTemp heating has a thermostat in every room

The *ultimate* in heating comfort—*a thermostat* in every room—is both simple and practical with the Iron Fireman SelecTemp heating system. Occupants of each room or office can select any temperature desired, at any time. Rooms stay at the selected temperatures. Each room unit automatically compensates for heat gains and losses caused by changes in outdoor temperature, cold winds and warmth from the sun—increasing or decreasing heat output.

SELECTEMP HIGHLIGHTS

THERMOSTAT IN EVERY ROOM. Temperatures can be varied in every room to fit the "activity plan" and personal preference of the occupants.

MODULATED HEAT. Air circulation is continuous. Both temperature and volume of air are automatically modulated, as required to offset heat loss from room.

FILTERED, CIRCULATED AIR. Individual room air circulation prevents transmission of odors or bacteria from other rooms. Air is cleaned by a spun glass filter in each room unit. Filtered outside air can be introduced if desired.

BOILER LOCATION. Boiler can be placed in any desired location, with proper distribution of heat to every room. Year-around domestic hot water coils available.

LOW POWER COST. No electricity required to operate circulating fans. Nonelectric thermostats.

LOW INITIAL COST. Easily installed in either new or old construction. Small soft copper tubing (¼ inch I.D.) carries steam to individual room heater units. Return lines are ⅛ inch. Substantial savings in installation costs.

LOW FUEL COST. Temperature easily reduced in unused rooms. Also eliminates overheating.

AUTOMATICALLY BALANCED. No special adjustments of dampers, valves or orifices required to balance heating system. Each unit continuously regulates heat needed for each room. Automatically compensates for external heat sources such as fireplace or solar heat, without affecting temperatures of other rooms.

ECONOMICAL INSTALLATION AND OPERATION

Regardless of the type or size of structure; office building, hotel or apartment house, school, hospital, or house, SelecTemp heating can be economically and efficiently installed. Flexible copper tubing, smaller than your little finger, carries low pressure steam to each room unit.

In addition to individualized heating comfort SelecTemp brings substantial operating savings. The fuel waste resulting from overheating (symptom: occupants open the windows), and the unnecessary heating of unused space, is eliminated. A fan in each room unit, operated by a steam turbine, continuously circulates filtered warm air. No electricity is used for fans or thermostats.

ASK FOR FULL INFORMATION

Before choosing a heating system for any building or residence, whether new construction or being modernized, it will pay you to get the facts about the Iron Fireman SelecTemp—a completely new concept in heating practice. Just mail the coupon or write.

Iron Fireman®

SelecTemp®

MODULATING ZONE HEATING

Send for free booklet

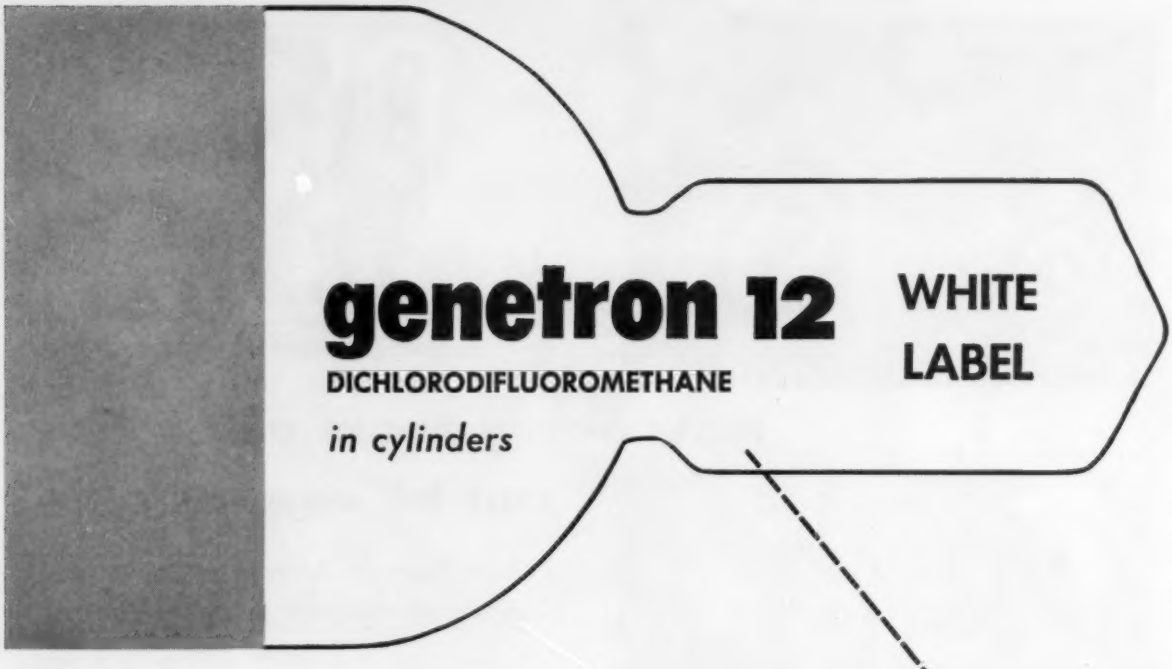
IRON FIREMAN MANUFACTURING CO.
3176 West 106th Street, Cleveland 11, Ohio.
In Canada, write to 80 Ward St., Toronto, Ontario.

Send literature on Iron Fireman SelecTemp heating.

Name_____

Address_____

City_____ State_____



YES ... genetron®

ARE COLOR-CODED

genetron...

Super-Dry
Refrigerants

Super-Dry Refrigerants

FOR YOUR CONVENIENCE!

It's always easy to know the contents of "Genetron" refrigerant cylinders or drums. That's because the top of each container is clearly marked with a distinctive color to identify which refrigerant it contains . . . and the labels are printed in matching colors to provide a double-check for you.

So, don't worry about learning long chemical names or confusing formulae. Just remember this: *In refrigerants, the name "Genetron" always identifies General Chemical's great line of "super-dry" refrigerants.*

And, the label color code always means:

- **WHITE LABEL** —DICHLORODIFLUOROMETHANE
- **GREEN LABEL** —MONOCHLORODIFLUOROMETHANE
- **ORANGE LABEL**—TRICHLOROMONOFLUOROMETHANE

For speed, simplicity, convenience, buy . . . order . . . specify "Genetron" Refrigerants by color!

GENERAL CHEMICAL DIVISION

ALLIED CHEMICAL & DYE CORPORATION

40 Rector Street, New York 6, N. Y.

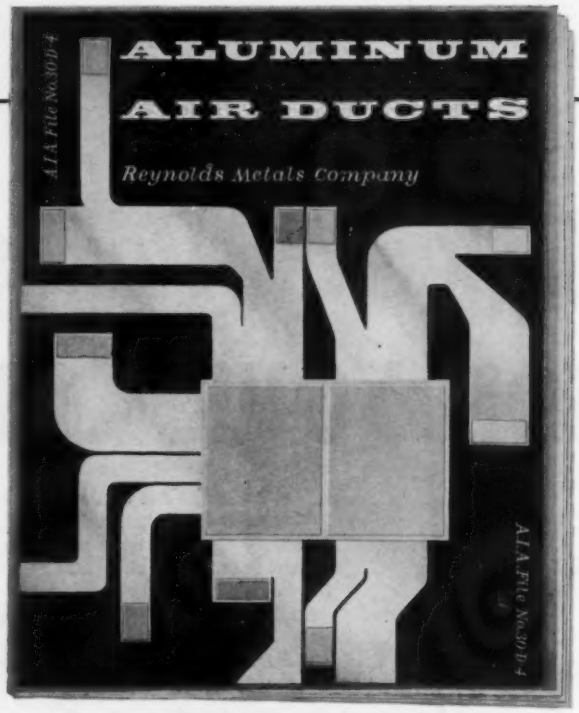
Offices: Albany • Atlanta • Baltimore • Birmingham • Boston • Bridgeport • Buffalo Charlotte • Chicago • Cleveland • Denver • Detroit • Greenville (Miss.) • Houston Jacksonville • Kalamazoo • Los Angeles • Minneapolis • New York • Philadelphia Pittsburgh • Providence • San Francisco • Seattle • St. Louis • Yakima (Wash.) In Wisconsin: General Chemical Company, Inc., Milwaukee

In Canada: The Nichols Chemical Company, Limited • Montreal • Toronto • Vancouver

GC Allied Chemical

America's Foremost Producer of Fluorine Chemicals

AIR CONDITIONING MAKES THIS NEW BOOK EVEN MORE IMPORTANT–



Aluminum ducts have advantages even in the simplest warm-air heating system. Its emissivity is lowest of any practical duct metal–approximately 5% compared to 25% for galvanized. And its smoother surface speeds air flow.

Its outstanding advantage, however, is freedom from rust. *And with today's air conditioning this quality becomes all-important.* Problems of moisture condensation–and danger of rust–are inevitable when ducts are used for air cooling as well as heating.

An authoritative Application and Data Handbook on Aluminum Ducts is therefore more necessary today than ever before. The manual illustrated has just been published by Reynolds.

Experts of air conditioning equipment companies have cooperated with Reynolds engineers in its preparation. You are cordially invited to use it.

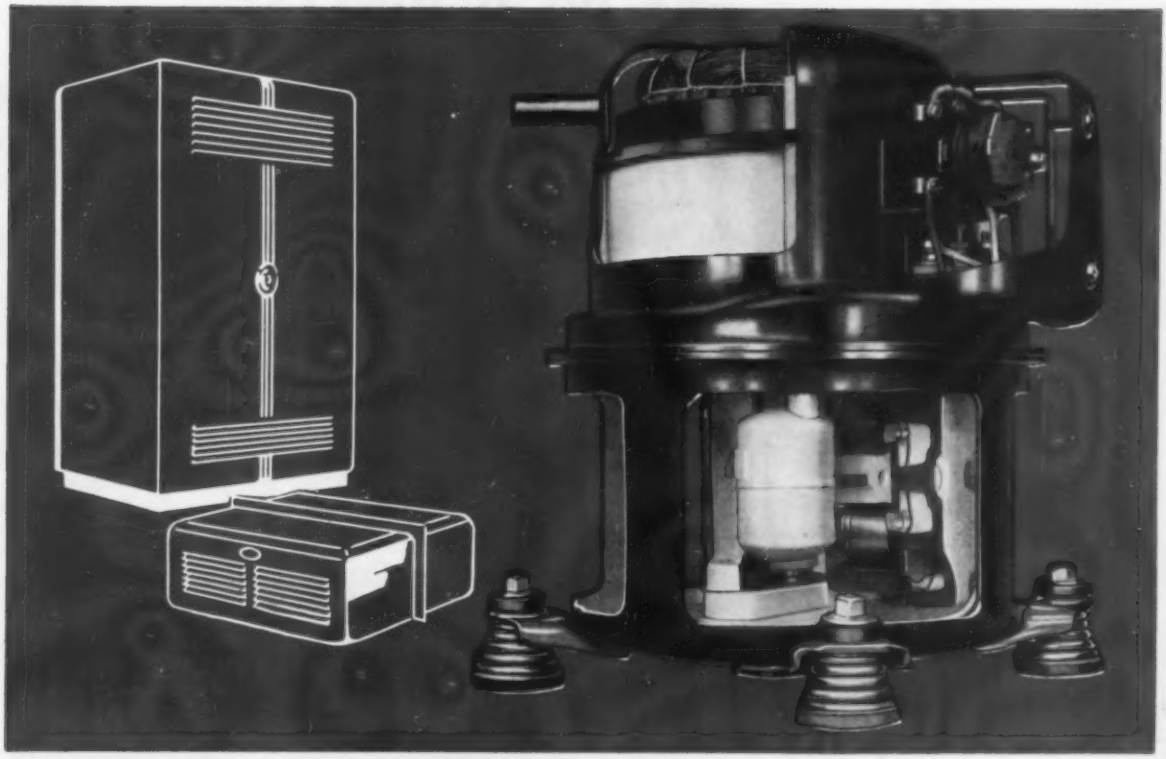
PLEASE WRITE FOR YOUR COPY ON YOUR COMPANY LETTERHEAD. REYNOLDS METALS COMPANY, GENERAL SALES OFFICE, LOUISVILLE 1, KENTUCKY

REYNOLDS ALUMINUM

See "MR. PEEPERS," starring Wally Cox, Sundays, NBC-TV Network

WHISPER-QUIET **POWER**

for package Air Conditioning



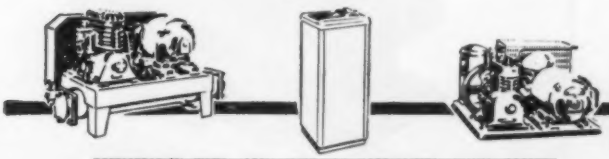
COPELAWELD *HERMETIC*

It takes real engineering (and knowledge of your customers' needs) to produce a welded motor-compressor that combines positive performance, vibration-free smoothness, and maximum operating economy.

Copeland gives you these design advantages and more . . . plus precision manufacture using finest components. Heavy-duty, high-power-factor motor delivers power aplenty with minimum current consumption. Freon-12 and Freon-22 models available. Use of Freon-12 can give you as much as 75°F. lower temperatures in windings, crankcase, oil and discharge side. Unusually high capacities make Copelaweld motor-compressors adaptable to virtually every type of duty.

Power all your air conditioning and refrigeration equipment with Copeland motor-compressors. It's *the* quality equipment that enhances your reputation by its long-run, trouble-free service.

Get full details . . . write today for complete information on the profit-making Copeland line.



REFRIGERATION UNITS (OPEN TYPE AND COPELAMETIC) WATER COOLERS

COPELAND REFRIGERATION CORPORATION · SIDNEY, OHIO

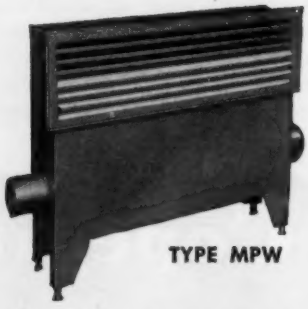
Copeland

DEPENDABLE REFRIGERATION

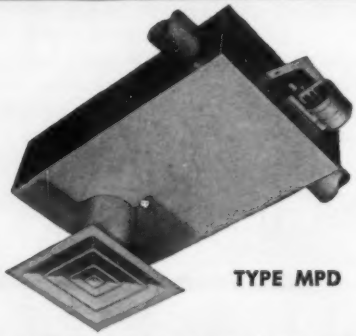
Air Conditioning Systems are on a diet...

thanks to

Tuttle & Bailey High Pressure Air Distribution Units



TYPE MPW



TYPE MPD

T&B HIGH PRESSURE INSTALLATIONS INCLUDE: Bethlehem Steel Co., Bethlehem, Pa. • Dallas County Building, Dallas, Texas Dearborn Bank, Dearborn, Mich. • Decatur-Macon County Hospital, Decatur, Ill. • General Telephone Exchange, Chicago, Ill.

IF YOU can reduce the space you need for an air conditioning system, you can obviously effect substantial savings in the over-all cost of a building. With a high pressure air conditioning system, you can do just that.

Small, low-cost conduit-type risers and branch feeders add more usable or rentable floor space, reduce floor-to-floor dimensions, and require fewer supplementary equipment rooms.

High pressure is the ideal type of air conditioning system for new multi-story office buildings, schools, hospitals, hotels, and institutions. It is also *particularly* well suited to installation in existing buildings where high pressure eliminates the need for major remodeling. In fact, in many older buildings, such a system is the *only* answer to air conditioning.

A pioneer in the development of the high pressure theory, Tuttle & Bailey manufactures a complete line of equipment to meet the varied requirements of a wide range of buildings and types of construction. Tuttle & Bailey Units include single and double duct wall and ceiling types for individual unit or zone control, and are capable of handling branch duct velocities up to 4000 feet per minute.

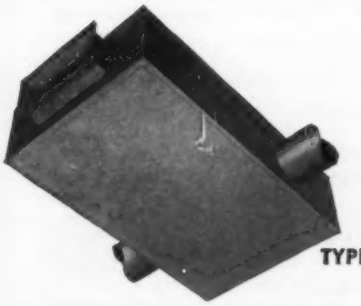
The units shown below typify the Tuttle & Bailey line which is backed by extensive on-the-job experience, and one of the best-equipped Research Laboratories in the industry where T&B engineers can duplicate field conditions and pretest equipment and thus offer maximum assistance to architects and engineers.

To learn how you can take advantage of Tuttle & Bailey's high pressure know-how, get in touch with your nearest T&B Representative or the Home Office.

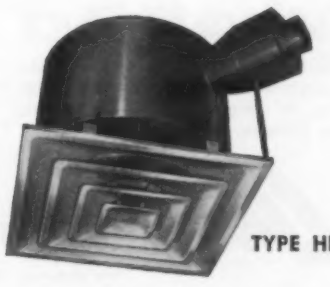
For information on the complete line of Tuttle & Bailey High Pressure Air Distribution Units, write for Bulletin 109.

TUTTLE & BAILEY inc

NEW BRITAIN, CONN.



TYPE MP



TYPE HPD

IBM World Headquarters, New York, N.Y. • Latter Day Saints Society Building, Salt Lake City, Utah • Lever House, New York, N.Y. People's National Bank, Little Rock, Ark. • Seamen's Bank for Savings, New York, N.Y. • Sinclair Oil Building, Tulsa, Okla.

another Lima first
... and at
no extra cost

SERIES 70

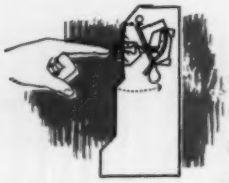
Lima Perimeter Extended Baseboard Diffuser
now features

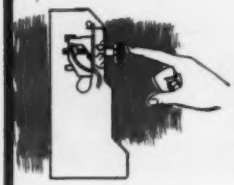
built-in

AUTOMATIC PUSHBUTTON Damper Control

PUSH IN

it automatically opens and locks into pre-balanced position.





PUSH UP

it automatically snaps closed for positive air shut-off.

EASY TO BALANCE

In either open or closed position simply turn pushbutton adjusting screw with fingers to correct valve setting for proper balance.

Again Lima is first . . . providing fingertip control of air in heating and cooling. This exclusive new Lima feature assures split second air shut-off whenever desired. The hinged damper runs full length of louver openings and snaps tightly closed with double spring action.

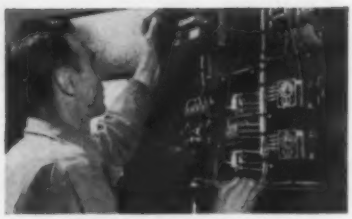
It is ideal for cooling — the positive spring tension eliminates rattling and keeps valve from being forced closed by the air velocity. Give your customers this modern convenience at no extra cost. Lima 2-foot and 4-foot sizes are now being shipped completely assembled — including the built-in mechanical damper and this new push-button control mechanism.

This identical unit may also be ordered without damper, as Series 75

Lima REGISTER COMPANY, LIMA, OHIO

MEMBER INDOOR COMFORT

Sold exclusively through heating wholesalers and manufacturers.



All electrical controls are checked through operational cycles.

Flue gas is analyzed to measure combustion efficiency of either gas or oil fired unit.

Draft pressure is checked to determine balance in combustion chamber.

Fan RPM, shaft and pulley alignment and belt tension critically checked.

Rugged "SHAKEDOWN" assures exceptional heater performance!

The Dravo combustion expert in the above photo is adjusting the oil pump on a 1,000,000 btu Dravo Heater as a prelude to exhaustive performance tests that all Dravo Heaters must pass before shipment.

While the heater is in operation, this Dravo specialist modulates burner from "off" to full firing and return. He measures combustion efficiency of burners and adjusts for best performance. Automatic controls are checked through every cycle, exhaust gas analyzed and stack temperature measured. Naturally, all mechanical parts are checked under operating conditions for quality workmanship, proper installation and alignment.

Other photos on this page give you an idea why the qualitative Dravo Heater tests are classified as the industry's most rugged and exhaustive . . . and are similar to "shakedown" cruises all ships of the U. S. Navy must pass.

The exceptionally low operating costs and long heater life that Dravo users enjoy don't happen accidentally . . . such advantages are assured by efficient design and exceptional quality control methods, like these final inspection tests. That's why Dravo Heaters can assure you longer heater life, economical operation and lower installation cost. For the best in heating, contact Dravo—today.

Dravo Corporation, Department A-1404
Fifth & Liberty Avenues
Pittsburgh 22, Pa.

I am interested in Dravo Heaters for _____ btu per hour

☐ Please send literature
☐ Please have a representative call

DRAVO
CORPORATION
Pittsburgh 22, Pennsylvania
Representatives in all principal cities

Name _____

Company _____

Address _____

City _____ Zone _____ State _____

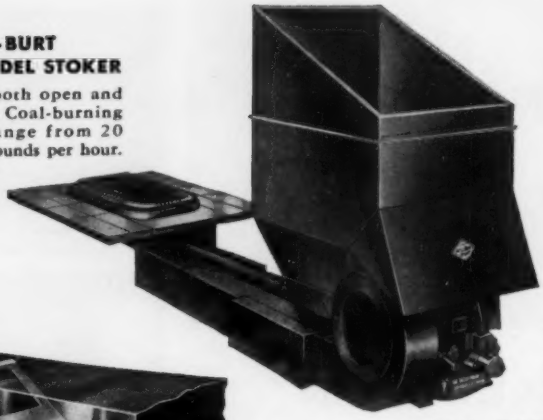
SAFE, CLEAN COAL HEAT

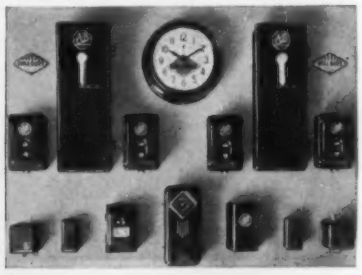
ENGINEERED FOR LOW COST TROUBLE-FREE OPERATION & MAINTENANCE—

Coal fired with a Will-Burt Stoker is the preferred method of heating wherever low-cost installation, clean coal heat and a factor of greater safety are of utmost importance. Will-Burt Stokers are engineered for application to a variety of coal burning boilers and furnaces, providing trouble-free performance, particularly where installations in schools, hospitals, churches, institutions, apartments and factory buildings require relief from maintenance throughout the heating seasons. The Will-Burt patented automatic air control delivers the correct quantities of air for complete efficient combustion during the operating and off periods—providing low-cost, clean coal heat. Prevention of smoke and soot, such as is usually prevalent when the fire is starved for air, is practically eliminated by air automatically induced to meet ever-changing fuel bed conditions.

WILL-BURT HOPPER MODEL STOKER

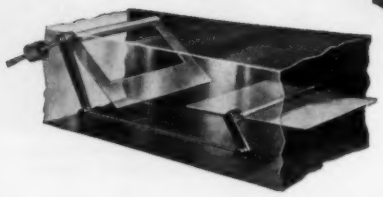
available in both open and closed hoppers. Coal-burning capacities range from 20 through 750 pounds per hour.





WILL-BURT CONTROL PANEL

Prewired, pretested control panel boards provide an interconnected control system for stokers to be operated by either a common operating and/or individual holdfire control, depending on the setting of the safety switch, off-on switch and timeswitch cycle. Mounting wall brackets are provided.



WILL-BURT AUTOMATIC AIR CONTROL

assures the proper combustion of fuel during the operating period as well as during the time the blower and feed screw are off. This patented device prevents a condition of smoke and soot. It allows for dissipation of any intense heat that may be surrounding the tuyeres or dead plate by permitting induction of normal draft to the fire bed. It automatically assures the most efficient combustion of bituminous coal in ever-changing fuel bed conditions.

ALL THESE ADVANTAGES WITH A WILL-BURT STOKER

WILL-BURT BIN FED STOKERS

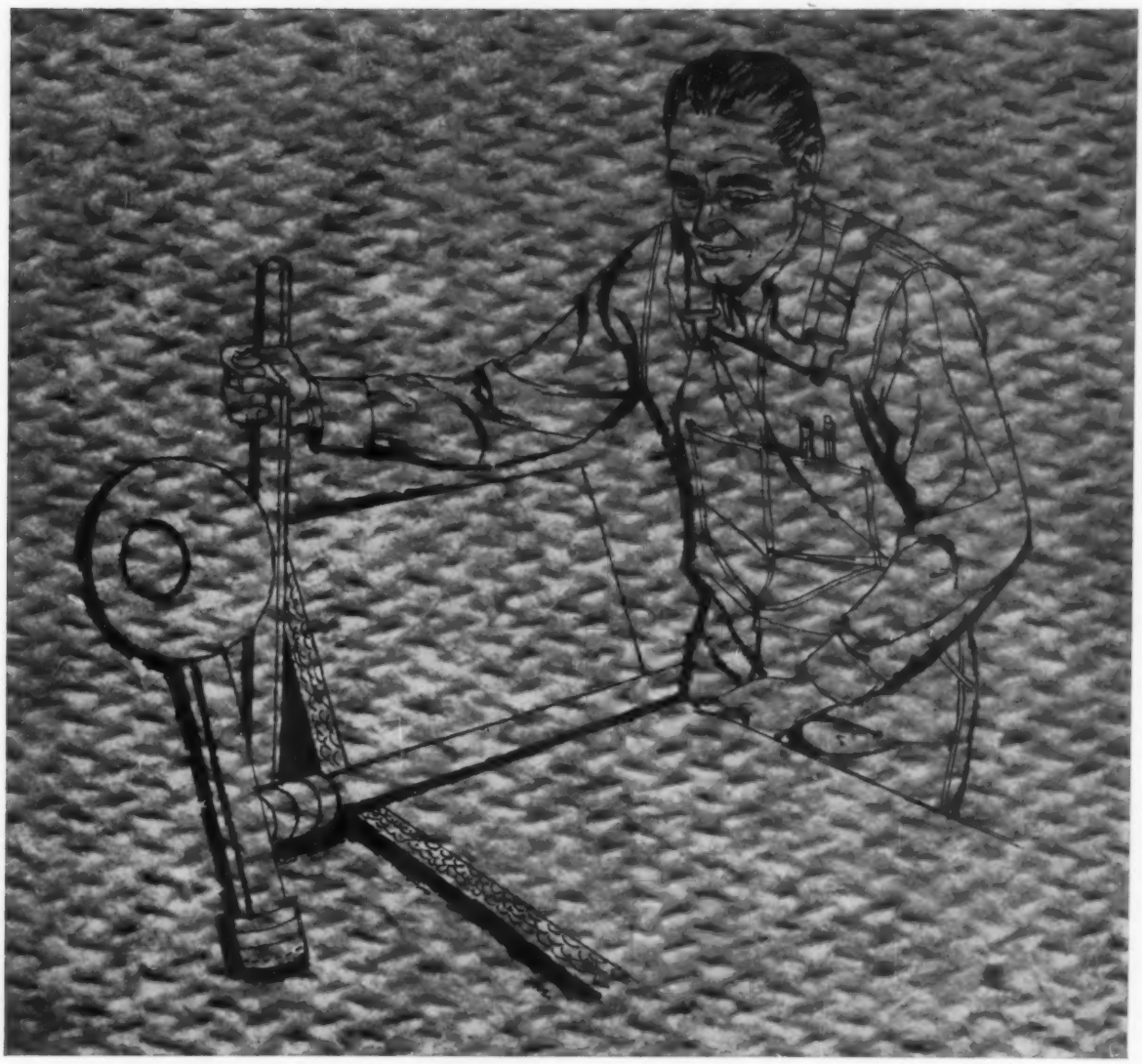
reduce cost of coal handling and maintenance to an all-time low. For application with various types of bituminous coal burning boilers and furnaces, in the same fuel capacity range as hopper models.

Write on your letterhead for the Will-Burt Stoker Data Book, complete with engineering information, dimension and installation drawings, suggested specifications, etc. A valuable reference book, especially for architects and engineers.

The WILL-BURT Company

OVER TWENTY-FIVE YEARS IN THE STOKER BUSINESS

BOX 902 · ORRVILLE, OHIO



Pittsburgh Superfine Fiber Glass speeds ductwork insulation

Wrap or liner, the use of Pittsburgh Superfine Fiber Glass will cut installation time—and provide the finest thermal insulation and sound absorption qualities. Lightweight, easy to handle, this soft, flexible fiber glass can be quickly cut with knife or shears to fit any sizes or shapes. It can be formed with the sheet metal or installed after fabrication. Applied with adhesives or tapes, with or without screws or clips, PPG Superfine saves money on installation.

Available in a wide range of roll lengths and widths and in all required thicknesses . . . unfaced or with cloth, asbestos, paper, aluminum foil or vinyl facings. For complete information write our executive offices or district sales offices in Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia or St. Louis. Pittsburgh Plate Glass Company, One Gateway Center, Pittsburgh 22, Pennsylvania.

FIBER PPG GLASS

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS

PITTSBURGH PLATE GLASS COMPANY

UNARCO

ROYAL-AIRE *a distinctive conditioner*

featuring UNARCO "pump-down" control system

It is doubtful that any air conditioner can match the efficiency and beauty of the UNARCO ROYAL-AIRE. This all-new conditioner provides "just right" cooling comfort, adding distinction to *any* setting.

Oversize cooling coils . . . accessible, hermetic motor-compressor units...and the exclusive UNARCO "pump-down" control system, which prevents compressor damage...are but a few outstanding features of the ROYAL-AIRE line.

Available in five capacities (3 to 15-ton) the ROYAL-AIRE is *balance-engineered!* This insures full cooling capacities and quiet operation under all conditions, producing a pleasurable climate and atmosphere for any size room.

The ROYAL-AIRE is eminently suited to comfort-cool dining rooms, taverns, drug stores, clothing stores, and offices...to cool wherever the *ultimate* in efficiency and long life is desired. Address Heating & Cooling Division for descriptive literature.

Union Asbestos & Rubber Company
332 So. Michigan Ave., Chicago 4, Ill.
Canadian Representative: Albern Universal Ltd., Toronto

UNARCO

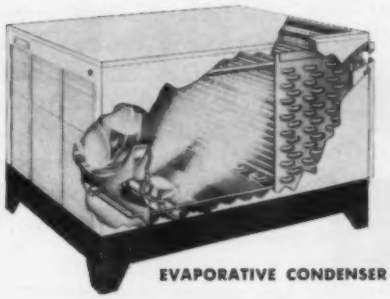
the *finest* in heating and cooling products *at no extra cost*

Original Equipment Manufacturers . . .

it takes dern special equipment to keep a TEXAN cool!*

* **Yessir,** it takes a mighty good piece of air conditioning equipment to cool a Texan in July. And if it'll cool a Texan, it'll cool anybody, anywhere! 'Cause Texas is the hottest place in this world or the next.

How you gonna know whether your equipment will stand up under fierce Texas heat? The best way we know is to use a Cobell "Aqua-Fog" Evaporative Condenser or Condensing unit with your equipment. We build Aqua-Fog right here in Texas, we test it here in Texas . . . and it keeps us cool here in Texas**. And that means it'll hold up *anywhere*, from Phoenix to Yonkers, and Las Vegas thrown in on the side. And you just can't ask for any better than that! ** **We're the coolest!**



EVAPORATIVE CONDENSER

EVAPORATIVE CONDENSER UNIT

Aqua-Fog is a new, different system

Cobell gives you a brand new evaporative condenser that combines forced air and water spray to achieve an exceptional degree of rapid heat transfer. Very good for small central units of two to five tons.

Eliminates water cooling tower.

Slashes water consumption up to 97%; no worry about water shortages.

Cuts power costs through reduced head pressure.

Saves space; locate it indoors or out.

Easy to install, service.

Available with or without compressor, compartment, specified to individual needs.

FIND OUT how you can make money by using Aqua-Fog with your equipment.

WRITE FOR detailed catalogue information.

COBELL INDUSTRIES, INC.
Box 1157 Ft. Worth 1, Texas

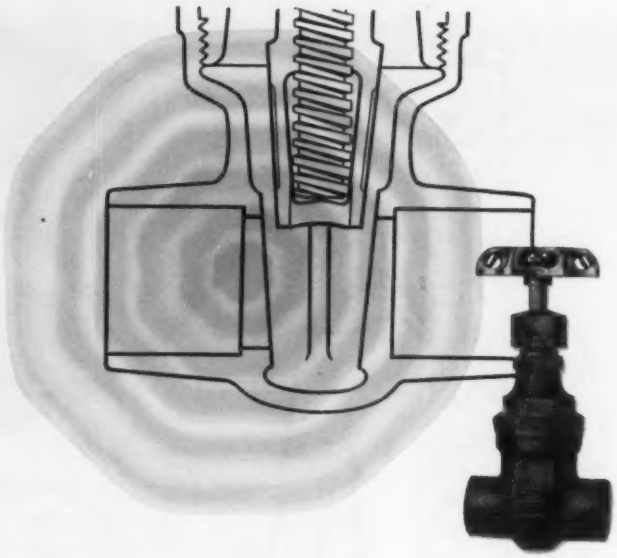
When the heat's on

you need the extra strength of

JENKINS

Solder and Socket End

VALVES



Solder End GLOBES and ANGLES

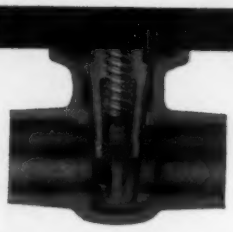
300 lbs. O.W.G.
¼" to 3"

Fitted with Renewable Composition Disc.

Solder End GATES

225 lb. and 300 lb. O.W.G.
⅜" to 3"

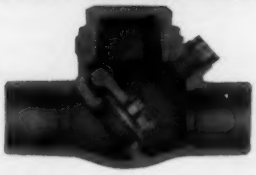
With solid or split wedges, and stationary or traveling spindles.



Solder End CHECKS

300 lbs. O.W.G.
¼" to 3"

Regrinding. May be easily reground without removal from line.



The "light-duty" look of copper tubing installations is deceiving. Valves must provide an accurate fit to tubing and *hold it* under the intense heat of soldering. And, because flexible tubing does not afford the rigid support of standard pipe, valves must withstand unusual strains in operation.

Jenkins Solder End Valves are engineered to meet these demands with strength to spare. High tensile bronze castings have liberal dimensions for extra rigidity. Smooth, clean bores assure accurate fit, easy soldering, positive seal to types K, L, and M Copper Tubing.

For faster, trouble-free installation, and lasting economy, specify Jenkins Solder End Valves. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS Socket End Valves
for Class B or IPS Tubing

Jenkins bronze valves with socket ends for silver-brazing are made in Globe, Gate, and Swing Check patterns to control compressed air, hot oil, and similar fluids in tubing hookups where specifications call for permanent, leakproof joints. Complete information in the Bulletin offered below.

NEW BULLETIN Lists all Jenkins Solder End and Socket End Valves and gives complete instructions for soldering and brazing. Ask for Solder-Socket End booklet.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros.

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS

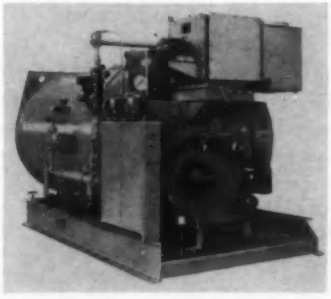
EQUIPMENT DEVELOPMENTS . . .

For reviews of Recent Trade Literature see Page 286

Branch Ducting For Air Conditioning

"Thermaflex," a new type branch ducting for high and low pressure air conditioning systems, is constructed of a continuous galvanized spring steel helix covered with a bonded three-ply laminate of glass fiber fabric sandwiched between two layers of aluminum sheeting, the manufacturer states. It is designed to be flexible, lightweight, flameproof and easy to install. Flexible Tubing Corp., Guilford, Conn.

Packaged Boiler Unit Needs No Refractory



The full wet back, sides and top of the manufacturer's packaged boiler unit eliminates the need for refractory to protect dry walls, the company states. Available in a range of sizes from 39 to 464 boiler hp, units are equipped with a horizontal rotary oil burner, says the manufacturer. The burner can be supplied for combination gas/oil firing with automatic change of fuels.

Controlled draft is provided by a v belted, motor driven induced draft fan, according to the company. This inducer is designed to pull the combustion gases through the unit to maintain the draft required for the particular stage of firing. Fitzgibbons Boiler Co., Inc., 101 Park Ave., New York 17.

Fractional Horsepower Single Phase Motors

A redesigned line of small fractional horsepower single phase motors, ¼ hp and smaller, is engineered with shallower endplates to reduce their length, and with ventilating openings located below the centerline for drip-proof construction, the manufacturer reports.

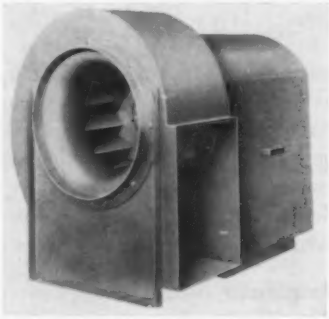
Sleeve bearing motors are lubricated by means of felt packing, cut to specified shapes and inserted in bearing housings with inner and outer seals, the company says. This type of construction is designed to prevent oil leakage and facilitate a constant supply of oil to the bearings. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14.

1-5 HP Transition Polyphase Motors

To be built in the old frame sizes and dimensions of the NEMA, a new transition polyphase motor line in the 1 to 5 hp range will be engineered to incorporate the features of the company's new "Tri-Clad 55" motor, the manufacturer reports.

The motors will be manufactured for the convenience of those users who cannot take advantage of the new NEMA dimensions. General Electric Co., Schenectady 5, N. Y.

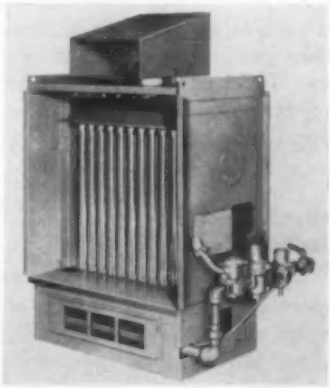
Centrifugal Blowers With Backward Curved Blades



Designed to be nonoverloading, a new line of centrifugal blowers with backward curved blades have arc welded steel frames and heavy gage steel housings, the manufacturer reports. Wheels have blades welded to heavy side plates which are bolted to a cast iron hub.

Motors to meet current characteristics and special operational requirements can be supplied, the company states. Hartzell Propeller Fan Co., Piqua, Ohio.

New Gas Fired Duct Furnace

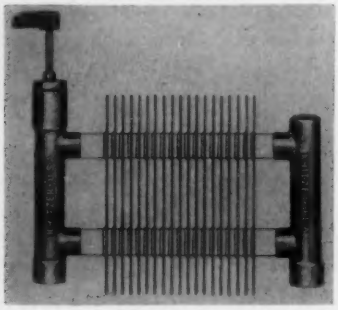


A new gas fired duct furnace designed for warm air heating, ventilating and air conditioning systems can be installed directly in the ductwork, with air circulated through it by a remotely located blower and can be installed as a single unit or as one of a series, depending on heating

requirements, according to the manufacturer. The unit can be installed either upstream or downstream from air washers and cooling coils in an air conditioning system, the company states.

In addition to its application in commercial, public and institutional buildings, the furnace meets industrial and agricultural requirements in the field of processing, curing and drying, the manufacturer says. Modine Mfg. Co., 1509 De Koven Ave., Racine, Wis.

Manifold and Valve For Hot Water Service



A new manifold and manifold type valve of a special cast brass alloy for hot water service is equipped with a sleeve type operator, can be dismantled for repacking for other service and provides a fast method of connecting baseboard radiation to branch piping, according to the manufacturer. The manifold is supplied with a ⅛ in. type outlet for a vent fitting. Kritzer Radiant Coils, Inc., 2901 Lawrence Ave., Chicago 25.

Panel Grids For Radiant Heating

"Anaconda PGs," a 16 mm motion picture showing the company's new concept of engineering and installing radiant panel heating systems with preformed copper tube panel grids, demonstrates the adaptability of these grids for various kinds of ceiling construction, as well as for radiant heating floor installations, the manufacturer announces.

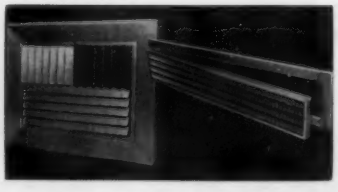
The grids are machine formed coils supplied in two standard panel sizes and two nominal diameters. The smaller panel grid is primarily for ceiling installation, while the larger is intended principally for use in floor installations, the company reports, American Brass Co., 414 Meadow St., Waterbury 20, Conn.

Bucket Steam Trap With Dual Valve

"Uni-Trap," a new type bucket steam trap, employs a balanced valve principle and automatically operates through complete pressure ranges up to 250 psi without adjustments, changing orifices, or valves, according to its manufacturer. It is recommended by the company for use in process industries where load and pressure range vary.

The dual valve, as shown, makes possible universal application, the manufacturer says. When the valve is filled with condensate, the bucket opens a small pilot valve, equalizing the pressure on both sides of the large main valve. The pressure, becoming balanced, allows the bucket to continue its descent and open the large capacity valve, thereby discharging the condensate rapidly, the company reports. Perfecting Service Co., 332 Atando, Charlotte, N. C.

Removable Core Type Air Diffuser



A removable core is a new development adaptable for use with both the company's "LCF" sidewall air diffusers and "B60" ceiling air diffusers, the manufacturer announces.

The core for the latter series is made in an unlimited number of shapes, with one, two, three or four way air patterns available, according to the company. When adapted to either series, it is designed to permit easy access to equipment in the air duct or for exchange of outlets in movable partition buildings without moving the mounting frame. Air Factors, Inc., 1624 S. Raymond Ave., Monrovia, Calif.

Oil Burning Boilers For Large Buildings

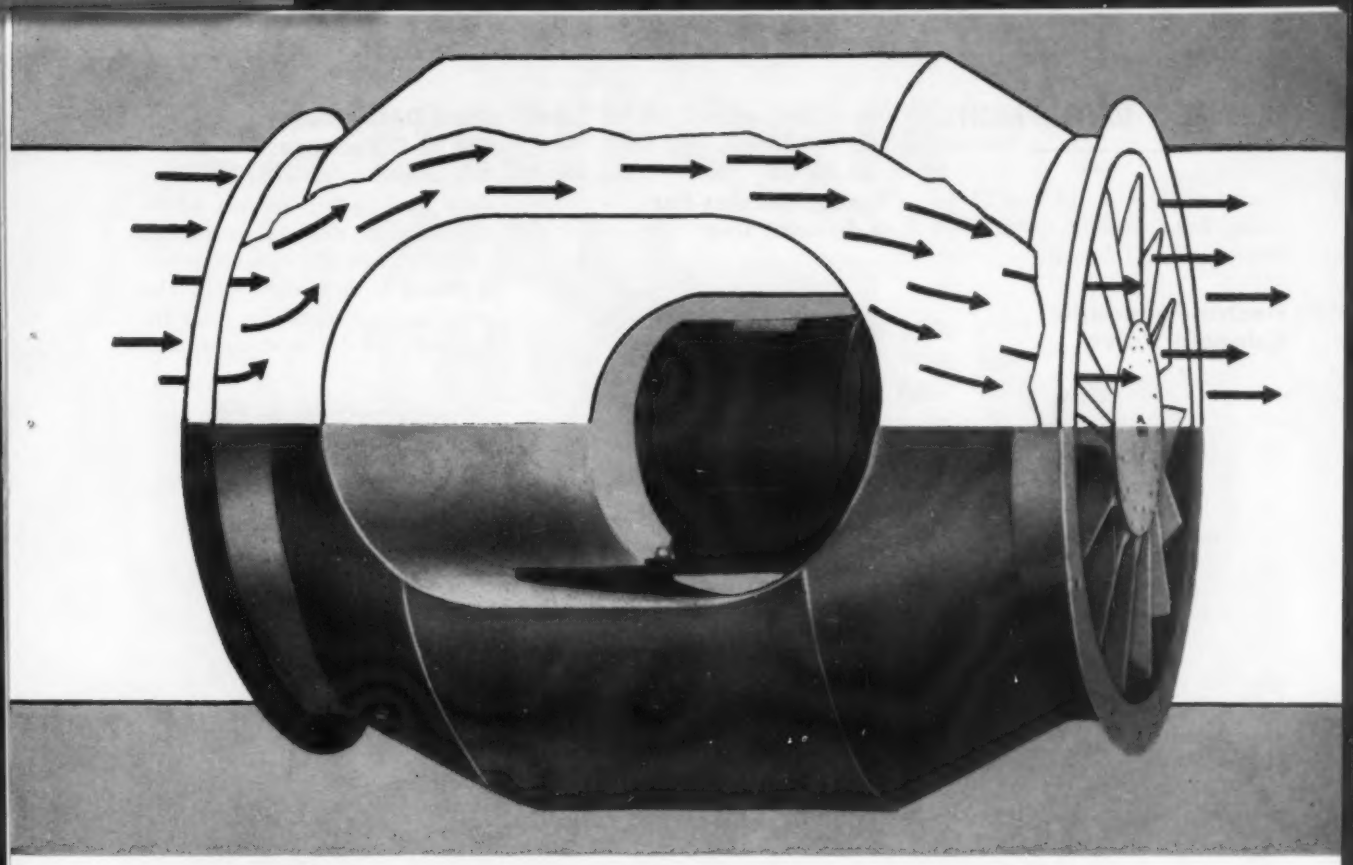
"Pace-King," a new line of cast iron, oil fired boilers for larger buildings, is available in 14 sizes with IBR ratings from 1100 to 4500 for steam and 1925 to 7200 for water, its manufacturer reports.

As a vertical-flue-travel unit, in only 24 in. of vertical travel between its cast iron sections, flue gas temperatures are reduced 800 deg, according to the company. Each section of the boiler has its own outlet direct to the smokehood—designed to facilitate correct flue ways regardless of the number of sections in the boiler, says the manufacturer. Burnham Corp., Irvington, N.Y.

Joint Wrap For Pipelines

"Duratape," a new joint wrap for underground pipelines, is designed as a dielectric barrier against corrosion, the manufacturer reports. The wrap is particularly suitable for hand wrapping field joints and fittings and oil and gas transmission and distribution lines, says the company.

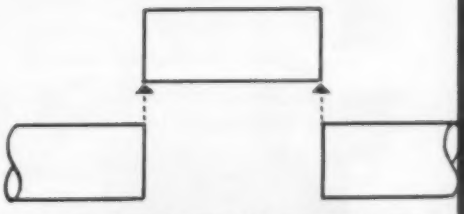
It is glass fiber bonded mat made of "Pyrex" type glass with reinforced strands of glass yarn, the manufacturer states. The entire mat is coated on both sides with plasticized coal tar. The tape is available in 50 ft



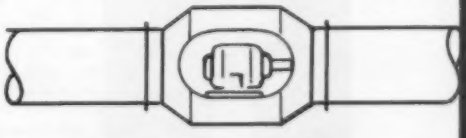
Bifurcator® Fan installs right in duct . . . to exhaust hot, corrosive, flammable, fumes

Solve that fume problem the modern way — with an easy-to-install Bifurcator Fan. This fan unit fits right into your duct system, just like a flanged section of ductwork. It requires no expensive platforms . . . no supports. And you needn't change the direction of air flow. A Bifurcator can be installed horizontally, vertically or at any angle. It's compact and neat in appearance . . . hardly any wider than the duct.

The Bifurcator is an axial-flow fan in a divided housing. Fumes bypass the motor which stays cool, clean and easy to inspect or maintain. Bifurcators can be constructed of cold rolled steel, stainless steel, rubber covered steel, monel metal, and many other corrosion-resistant materials. They can also be coated with Heresite, Ucilon, Tamanite, Herecrol R-9 sprayed synthetic rubber and other coatings. Bifurcators are available with fan wheels from 12″ to 48″ in diameter, with exhaust capacities up to 45,000 CFM. Send now for free catalog.



1. DUCT SECTION COMES OUT



2. BIFURCATOR GOES IN

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Division of American Machine and Metals, Inc.
East Moline, Illinois

Send me free Catalog DB-4-53 on Bifurcators for exhausting hot, corrosive, flammable and explosive fumes.

FIRM NAME

ADDRESS

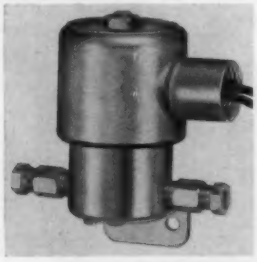
CITY ZONE STATE

NAME AND TITLE

EQUIPMENT DEVELOPMENTS
Continued

lengths of 2, 4, 6, 18 and 24 in. widths. L-O-F Glass Fibers Co., 1810 Madison Ave., Toledo 2.

Electro-Pneumatic Solenoid Valve



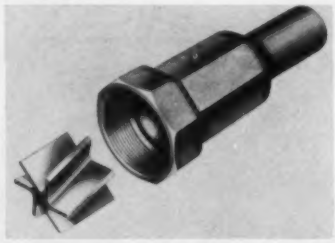
A new electro-pneumatic switch, designed for quiet operation, has spring, armature and guide tolerances and material specifications closely held to prevent a-c hum, according to the manufacturer.

When energized, the valve passes full air at supply pressures up to 25 psi, says the company. When de-energized, the supply port is stopped and the return line pressure is wasted to atmosphere. A built in manual adjustment is designed to permit the valve to open when the coil is de-energized. Powers Regulator Co., Skokie, Ill.

New Liquid Level Control Electrode

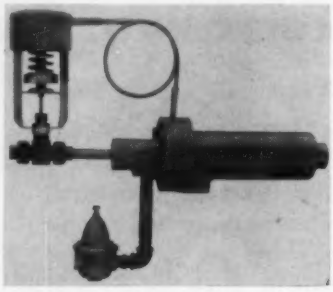
A new high pressure liquid level control electrode is designed to withstand pressure up to 4000 psi and temperatures up to 800 C, its manufacturer reports. Available in a series, electrodes are equipped with connecting nuts for attaching probes of any desired length or shape, according to the company. Auburn Spark Plug Co., Auburn, N. Y.

Spray Nozzles For Industrial Use



A new line of 15 deg injector type "FullJet" spray nozzles, in sizes from 1 ¾ to 17 in. in length and capacities from 1.5 gpm at 10 psi to 1108 gpm at 100 psi, is designed for use in a variety of industrial and chemical applications where a combination of heavier impact, fairly compact full cone spray, and wide choice of capacities is desired, the manufacturer announces. Spraying Systems Co., 3219 Randolph St., Bellwood, Ill.

Steam and Water Mixer For Process Industries

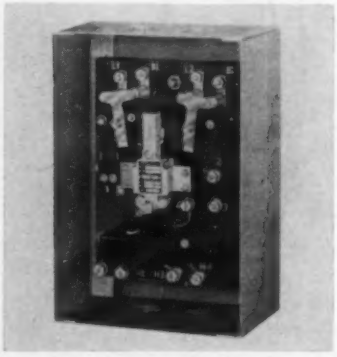


The No. "1360" series, a new steam and water mixer that is designed to utilize full heat energy by injecting steam directly into the water, may be used wherever hot water is required and steam and water are available, the company reports. It has a wide range of adaptability in industrial plants for processes of various kinds, says the manufacturer.

A safety feature on the control is designed to shut down the mixer in the event of failure of the water supply. Operation is automatically resumed when the interference is corrected. Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Box 400, Knoxville.

Time Delay Relay For A-C Voltages

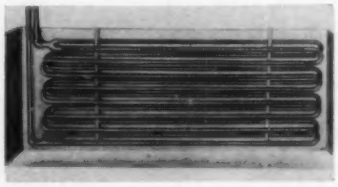
With a new time delay relay, any delay from ½ to 6 sec may be obtained for all standard a-c voltages (120, 240, 460, 600 volts, 60 cycles), according to the manufacturer. This relay is also available for other frequencies, and d-c, the company says.



The motor is built with a brake winding superimposed upon the stator winding of a conventional squirrel cage motor. Each time the drum switch is operated to the motor stop position, the relay closes, energizing the brake winding, the manufacturer reports. Automatic Switch Co., 391 Lakeside Ave., Orange, N.J.

Grid Heaters For Liquids

For heating of solutions in plating tanks, rinse tanks, caustic tanks and for general fluid heating service, the manufacturer's "Hi-Therm" grid heaters feature a maximum amount of prime heat transfer surface in a limited space, says the company.



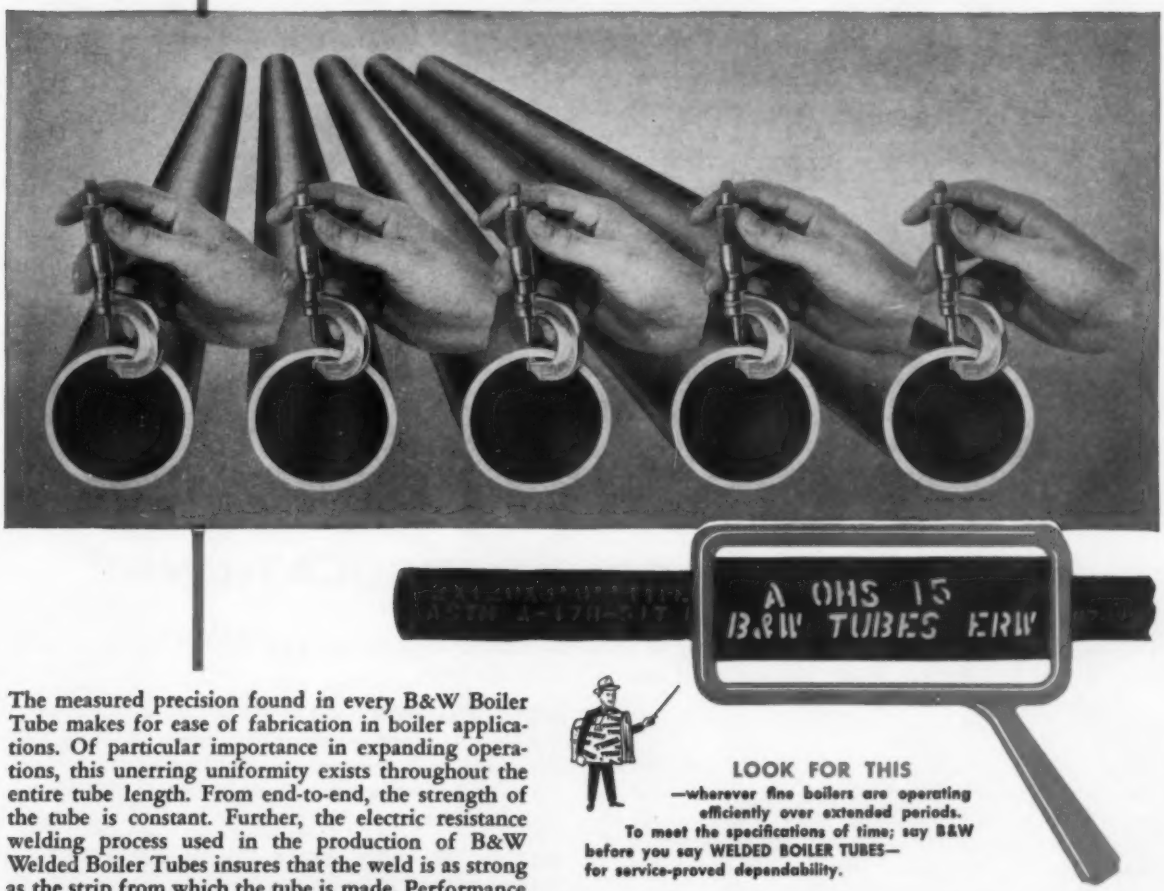
The installation of one grid heater on the back wall of the tank is all that is necessary in most cases where solutions are to be heated to boiling, the manufacturer reports. It can, however, be used on side or bottom of the tank with horizontal or vertical supply and return. Rempe Co., 340 N. Sacramento Blvd., Chicago 12.

(*Continued on page* 245)

you get

UNIFORM WALL THICKNESS

with B&W *Welded Boiler Tubes*



The measured precision found in every B&W Boiler Tube makes for ease of fabrication in boiler applications. Of particular importance in expanding operations, this unerring uniformity exists throughout the entire tube length. From end-to-end, the strength of the tube is constant. Further, the electric resistance welding process used in the production of B&W Welded Boiler Tubes insures that the weld is as strong as the strip from which the tube is made. Performance in service, the true test for any product, has proven that B&W ERW Boiler Tubes pay their way . . . longer and with an evenness of operation that means long-run savings for you.

For three quarters of a century, B&W has been directly concerned with developing and applying boiler tubes for all pressures up to those approaching 3000 psi. The application of this extensive knowledge and experience results, naturally, in the production of finer welded boiler tubes.

For ease of fabrication and long service life specify B&W ERW Boiler Tubes for the tubing in your boilers.

LOOK FOR THIS

—wherever fine boilers are operating efficiently over extended periods.

To meet the specifications of time; say B&W before you say WELDED BOILER TUBES— for service-proved dependability.

B&W SEAMLESS and WELDED TUBES

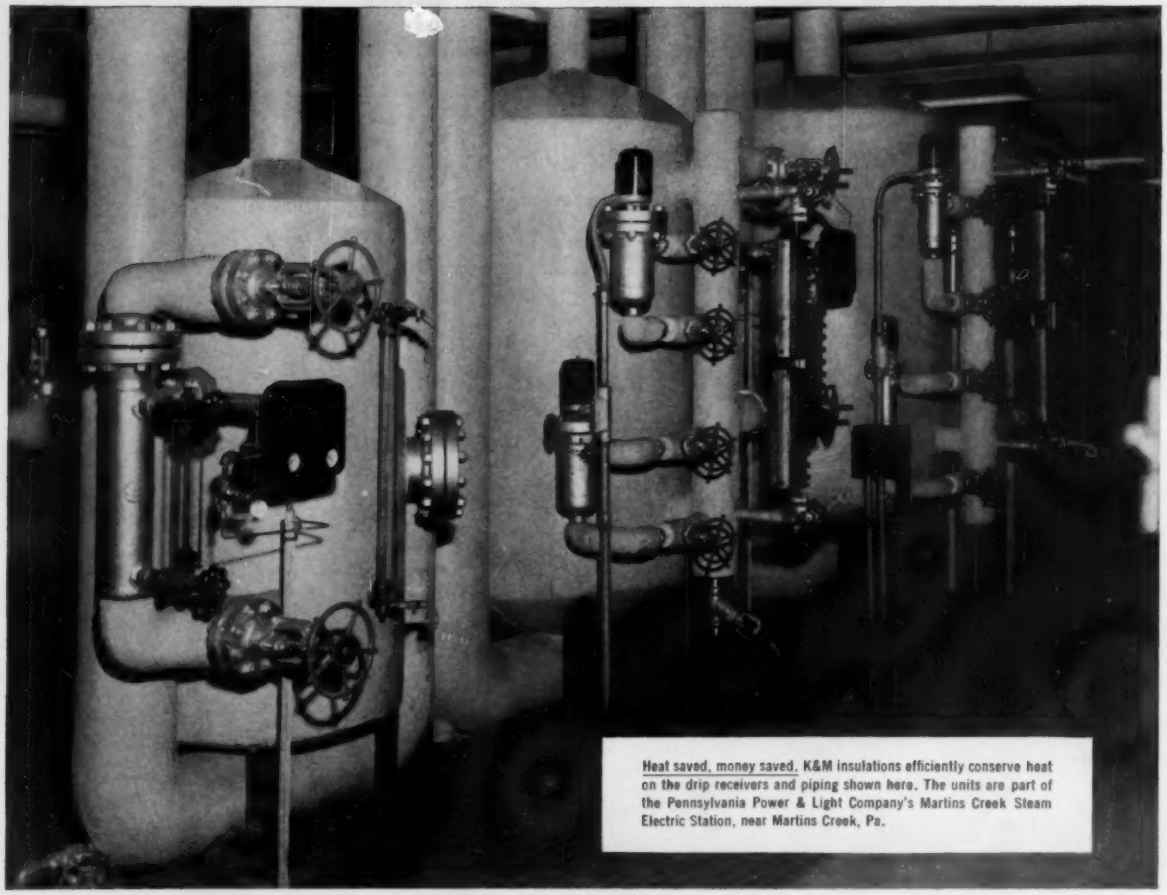
TA-4026 (CWP)

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing

Alliance, Ohio—Welded Carbon Steel Tubing



Heat saved, money saved. K&M insulations efficiently conserve heat on the drip receivers and piping shown here. The units are part of the Pennsylvania Power & Light Company's Martins Creek Steam Electric Station, near Martins Creek, Pa.

Keep Heat Losses Down with

K&M HIGH PRESSURE INSULATIONS!

Efficient heat conservation means *real* dollar savings. Get those savings by using K&M high pressure insulations—known for years for their exceptional efficiency in minimizing heat losses.

K&M "Featherweight"® 85% Magnesia and K&M Hy-Temp Insulation last the life of the equipment they serve. They withstand moisture, vibration, and frequent temperature changes. Both are supplied in various sizes and thicknesses. When used together, these materials—with staggered joints—eliminate the heat loss that normally occurs in single layer installations when expansion causes joints to open.

Efficiency to 1900° F. K&M Hy-Temp Insulation is used on applications where temperatures rise to 1900° F. It's made of diatomaceous silica combined with heat-resistant mineral fillers and asbestos fiber. Usually, it's applied in combination with K&M "Featherweight" 85% Magnesia.

Efficiency to 600°F. K&M "Featherweight" 85% Magnesia is used for effective insulation of piping and equipment with temperatures up to 600° F. 85% of this material is composed of basic carbonate of magnesia, the remainder of asbestos fiber.

Efficiency to 450°F. K&M "Featherweight" Water-Resistant Magnesia Insulation is used on equipment with temperatures up to 450° F. It is especially effective where severe water exposure may damage insulation, or where high humidity and moisture are present.

Act today. Don't let continued heat losses keep operating expenses piling up. Contact your K&M distributor for information on these insulations, or write directly to us.

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Manual and Fully Automatic softeners in capacities up to 1,500,000 grains are carried in stock. Larger capacities and special equipment to treat unusual water conditions engineered to meet your requirements.

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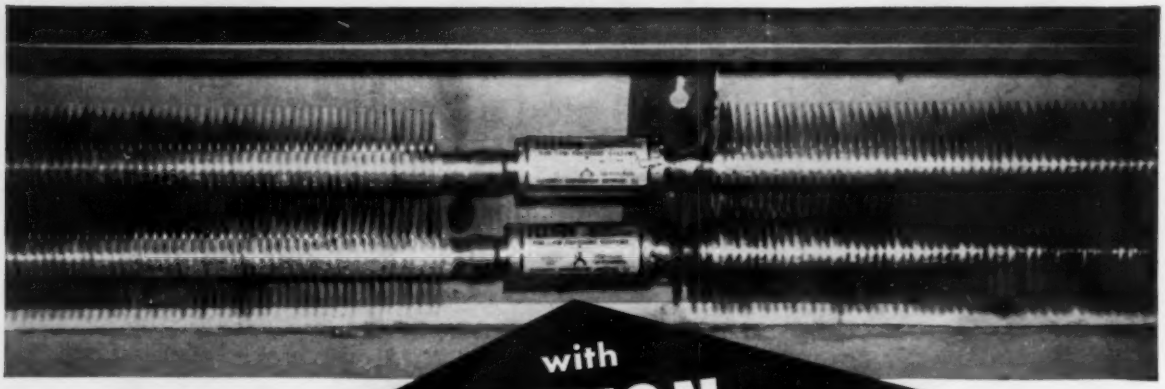
Sales Offices in Principal Cities • Plants in Milwaukee and Santa Barbara

Get heating system expansion problems under control... *economically!*



with

FLEXON EXPANSION COMPENSATORS

For medium and high pressure piping — FLEXON EXPANSION JOINTS

FREE FLEXING TYPE — Available in sizes from 3″ through 48″, I.D. in copper or stainless steel. Suitable for pressures from vacuum to 30 psi and temperatures from −20° F. to 850° F. Flanges or welding ends.

CONTROLLED FLEXING TYPE — Available in sizes from 3″ through 24″, I.D. with copper or stainless steel pressure carrier and cast iron control rings. Suitable for pressures from vacuum to 300 psi and temperatures from −20° F. to 850° F. Flanges or welding ends.

SPECIAL TYPES — A variety of assemblies are available for special requirements including special very high pressure units for pressures to 5500 psi. For recommendations send an outline of your requirements.

DESIGN GUIDE — The Flexon Expansion Joint Design Guide is a 24 page handbook on the selection and application of expansion joints. Write for your free copy, today.

● Now you can get expansion in heating system lines under control . . . you can end leakage resulting from uncontrolled expansion . . . you can minimize pipe creeping noises. And you can do all this at a price that doesn't throw your costs out of line. The answer is the Flexon Expansion Compensator.

The Flexon Expansion Compensator consists of a two ply corrosion resistant bellows with copper tube end connections. The bellows section is enclosed in a floating protective brass shroud. Designed to handle axial motion up to ½″, it is suitable for temperatures from −60° F. to 300° F., pressures up to 40 psig. Sizes are ¾″, 1″, 1¼″ and 2″. The 2″ size has threaded fittings. Threaded fittings are also available on smaller size.

Check the advantages of Flexon Expansion Compensators before you go any further on that heating job. Contact your local Flexonics distributor for further information or use the coupon below to get your copy of a descriptive bulletin.

Flexonics *Corporation*

Flexon identifies products of Flexonics Corporation that have served industry for over 53 years.

EXPANSION JOINT DIVISION
1391 S. Third Avenue
Maywood, Illinois

Flexonics Corporation
1391 S. Third Ave.
Maywood, Ill.

Please send me the bulletin which describes and gives full specifications for the Flexon Expansion Compensator.

Name .....

Company .....

Address .....

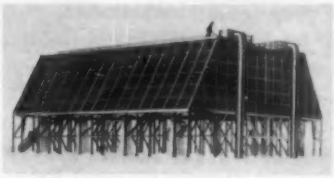
City ..... *Zone* .... *State* .....

My Wholesaler is: .....

EQUIPMENT DEVELOPMENTS

From p. 240

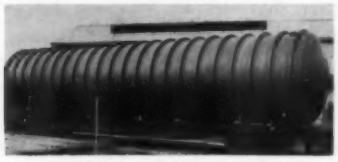
Cooling Tower Features Controlled Recirculation



Component parts of the manufacturer's "Wind-trol" cooling tower have been rearranged to eliminate the hampering effect of wind on its performance, the company states.

The change in arrangement, according to the manufacturer, nullifies the effect of recirculation caused by the tower structure upon itself. Uncontaminated air is allowed to pass beneath the structure and supply fans on both sides of the tower with an excess of air discharging from the tower's leeward side. Recirculation is prevented since the exhaust vapors must move against this discharging wind stream, the company says. Santa Fe Tank & Tower Co., Inc., 5401 S. Boyle Ave., Los Angeles 11.

Large Capacity Storage Tank



Shown is the first of nine similar storage tanks being delivered by its manufacturer to a particular installation. Measuring 62 ½ ft long by 12 ft in diameter, it is the largest yet fabricated by the company.

Weight of the tank when empty is approximately 46,000 lb and when filled with 55,000 gal of water it weighs nearly 500,000 lb, the manufacturer reports. American District Steam Div. of ADSCO Industries, Inc., North Tonawanda, N. Y.

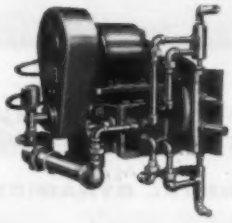
Special Tempered Glass Heating Element

The "Crystalite" heating element, fused in a special "perma-tempered"

SUPERIOR
combination GAS/OIL burners

Whatever the fuel . . . light or heavy oil, natural, manufactured, propane or butane gas . . . Superior Combination Burners will burn it Safely, Efficiently, Economically, and Automatically. Change-over from one fuel to the other is made in a matter of minutes without interruption of steam supply, and without disturbing or making any change in the equipment.

The Superior Gas Burner consists of a circular row of stainless steel nozzles set in a cast-iron gas manifold ring. The angle of the nozzles shapes the fire to the firebox. Combined with the Superior Oil Burner, the same fan supplies primary air for firing either gas or oil. For safety, a *constant* gas pilot guards every gas-firing cycle. For complete details write for catalog 2604.



Shown here is the other side of the SUPERIOR Rotary Burner with its 4-hole hinge, V-belt drive, dual pumps and reservoir.

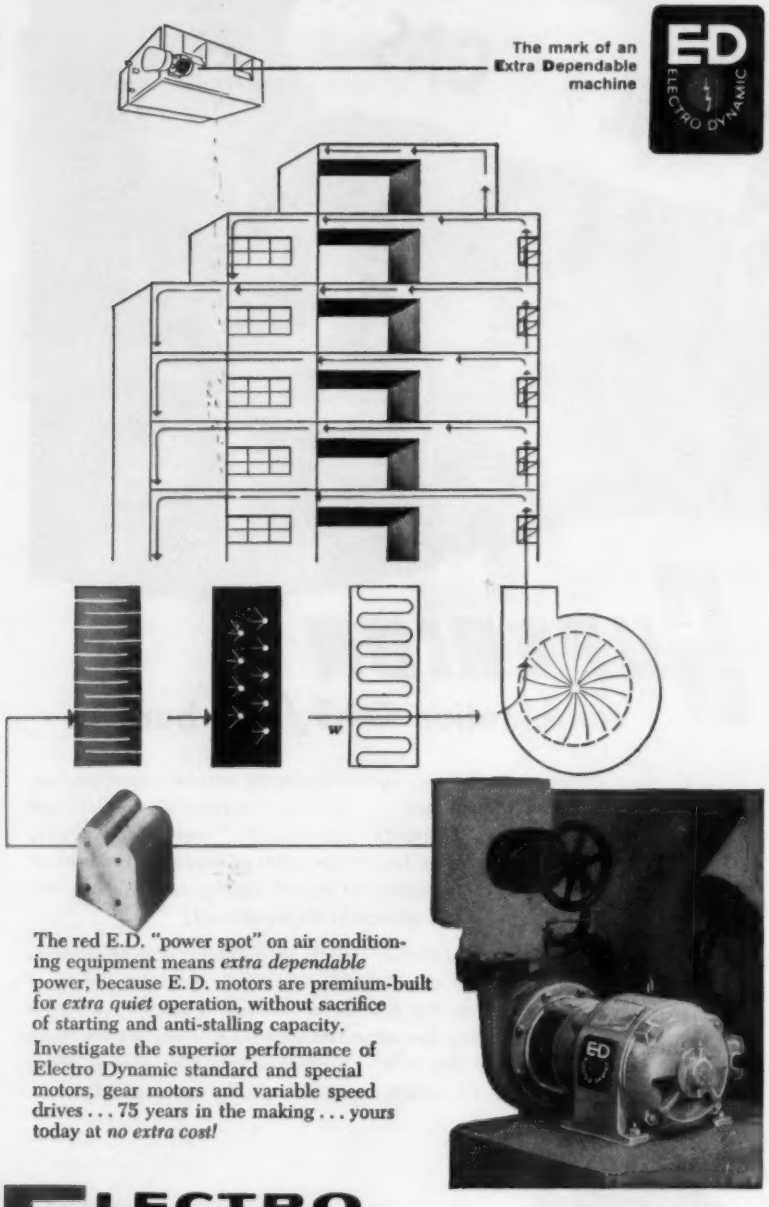
for performance you can BANK on

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR ROTARY BURNERS

a better kind of power

for the **air conditioning** industry



The red E.D. "power spot" on air conditioning equipment means *extra dependable* power, because E.D. motors are premium-built for *extra quiet* operation, without sacrifice of starting and anti-stalling capacity.

Investigate the superior performance of Electro Dynamic standard and special motors, gear motors and variable speed drives . . . 75 years in the making . . . yours today at *no extra cost!*

ELECTRO DYNAMIC
Extra Dependable motors

1 to 250 hp. AC and DC. Standard or special purpose. N.E.M.A. standards.

GD

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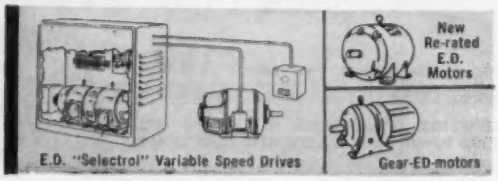
NEW...

Write for Brochure 100 and literature on new E.D. motors and drives.

Electro Dynamic division of General Dynamics Corporation
Bayonne, New Jersey



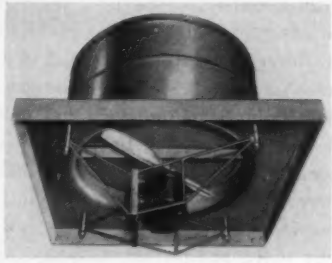
EQUIPMENT DEVELOPMENTS

Continued

glass, is said to produce a very durable and efficient radiant electric heating panel. This panel is designed to produce an instantaneous, even flow of heat to all parts of the plate through an element permanently fused with the glass.

A special coating on the back of the plate provides additional reflectivity and prevents electrical leakage from the element, the manufacturer reports. Crystalheat Co., Van Nuys, Calif.

Roof Ventilator For 6000 to 26,400 Cfm



The new "Vertiflow" roof ventilator consists of a galvanized steel windband mounted over a curb base of heavy galvanized steel, the company reports. The fan mount is bolted directly to the base, with the inner diameter in the base formed into a fan ring.

Lids in the windband turn on plastic bearings, opening when the fan is on, closing when it goes off, according to the manufacturer. The unit is available in 18, 24, 32, 36 and 42 in. models, with capacities from 6000 to 26,400 cfm, says the company. Hartzell Propeller Fan Co., Piqua, Ohio.

Stainless Fittings For Standard Pressures

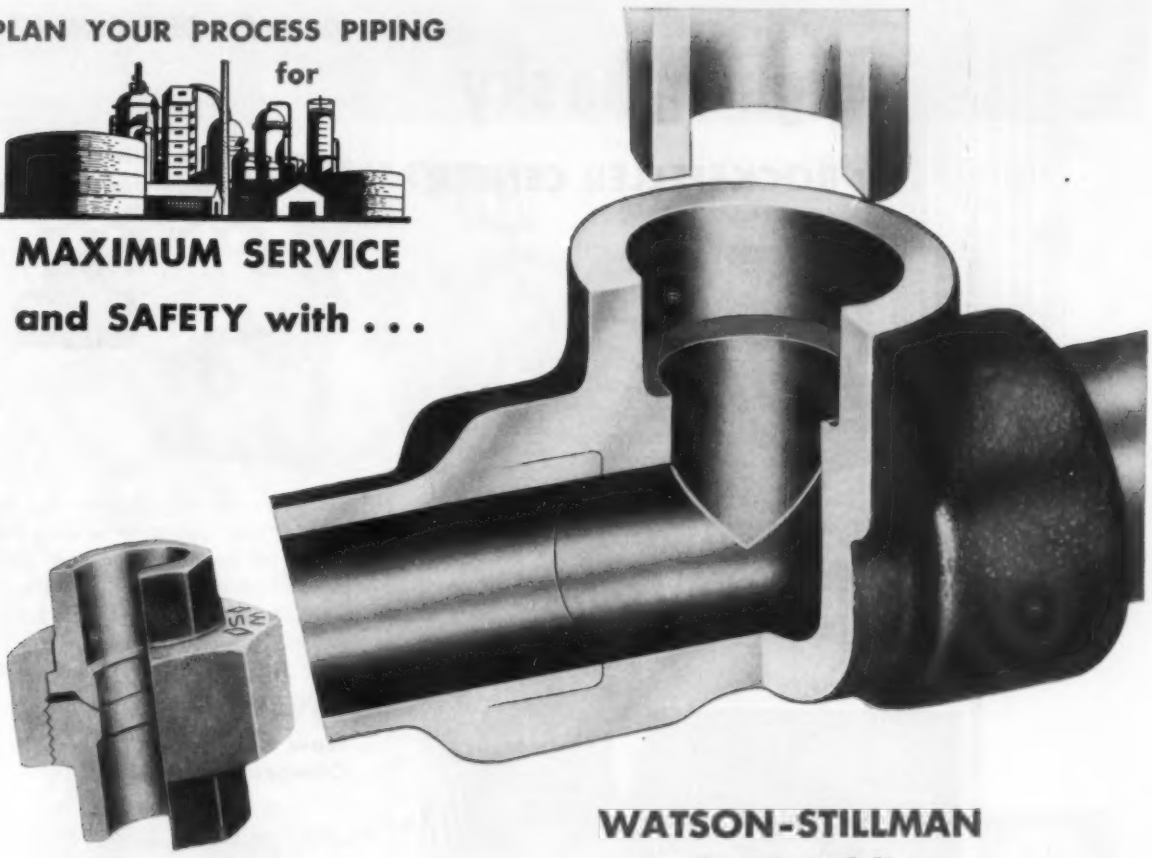
The manufacturer's new 150 lb stainless steel pipe fittings are designed for standard pressure services where corrosion is a factor, the company reports. Type "304" stainless steel, with a chromium content of 18 percent and nickel 8 percent, is formulated to be resistant to corrosion and high temperature oxidation. Type "316" has a chromium content

PLAN YOUR PROCESS PIPING

for

MAXIMUM SERVICE

and SAFETY with . . .



WATSON-STILLMAN
Socket-Welding
FORGED STEEL FITTINGS

In high pressure steam lines...process liquid and gas piping...hydraulic fluid lines...wherever strong, tough pipe joints are needed, Watson-Stillman Socket-Welding Fittings provide a safety factor against costly piping failures. Drop-forged of high quality steel, they readily resist pressure, heat, corrosion, shock and vibration.

W-S Socket-Welding Fittings are easy to install. Deep sockets support and align the pipe for welding. No need for tack welding or special fixtures. And the outside-the-pipe fillet weld prevents welding icicles inside the pipe.

Watson-Stillman Forged Steel Fittings are available in carbon, stainless and alloy steel for Schedule 40, 80, 160 and XX pipe. Sizes ¼" to 4". A complete line of forged screw-end fittings is also available.. Send today for Free catalogs.

Sold Through Leading Distributors

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H. K. PORTER COMPANY, INC.

Roselle, New Jersey

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high in the sky
at ROCKEFELLER CENTER

WALDRON Couplings

Each of the nine PHILLIPS Cooling Towers shown atop this world famous building was equipped with a WALDRON Floating Shaft Coupling to insure trouble-free operation and extra protection against corrosion. The couplings have stainless steel shafts, bolts and nuts and all parts are treated with a zinc base coating and have an iridite finish. Wherever distance between driver and driven equipment presents a problem, a WALDRON Floating Shaft or Spacer Type Coupling will solve it.

WALDRON couplings are available in sizes up to 18" shaft diameter. We specialize in furnishing couplings for unusual applications and services. We would be pleased to send you our latest bulletin 55-H upon request.

JOHN WALDRON
CORPORATION
New Brunswick, N. J.
Since 1827

Sales Representatives In Principal Cities

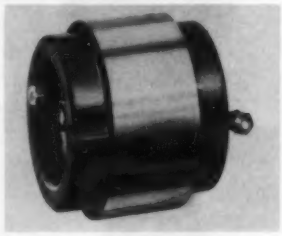
EQUIPMENT DEVELOPMENTS

Continued

of 18 percent also, is 11 percent nickel and has 2 ½ percent molybdenum. Molybdenum is said to increase the corrosion resistance to a wide variety of services.

The manufacturer expects the fittings to find application in chemical plants, refrigeration, food and other process industries, as well as in general industrial and laboratory applications. Watson-Stillman Fittings Div., H. K. Porter Co., Inc., 342 Madison Ave., New York 17.

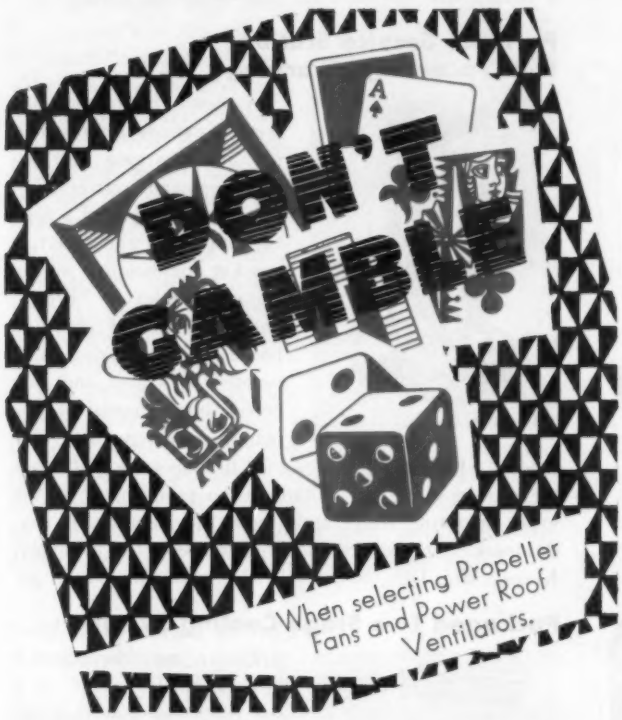
New Concept In Compressor Design



A new concept in compressor design by which the actual compressor mechanism is placed inside the electrical driving members, has been developed jointly by Wetmore Hodges & Associates and Shell Chemical Corp., Shell announces. The concept has reduced the overall size of the unit to one-fourth the size of a conventional motor driven compressor, according to the company.

Two main factors that led to the success of this idea are cited by the company: First, the gear type compressor was designed so that the ring gear drives the inner pinion—thus obtaining a positive seal at the back of each pinion tooth rather than the front. Second, "Epon" resins are used to impregnate the stator windings to seal them against moisture or chemical attack.

The MASSACHUSETTS Line®



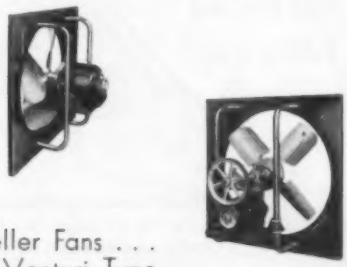
OUR 76TH YEAR

● MASSACHUSETTS ●

Propeller Fans and Power Roof Ventilators are studded with well engineered features and modern developments.

They meet the requirements of the extreme performances demanded from this type unit.

Power Roof Ventilators . . . Propeller Fan Type . . With venturi type inlet orifice. Direct drive 12 to 30 inch wheel dia. . . Belt drive 24 to 48 inch wheel dia. . . Bulletin No. 119 for complete capacity ratings and dimensions.



Propeller Fans . . . With Venturi Type Steel Panel . . . Belt Drive 24 to 48 inch wheel dia. . . Direct Drive 12 to 30 inch wheel dia. . . A complete line of accessory items are available, Fan Houses, Shutters, etc. Bulletin No. 117

Power Fixed (backward curve blade) Type . . . Direct Drive 13 to 18 inch wheel dia. . . Belt Drive 15 to 60 inch wheel dia. . . Features include curved inlet, rugged construction, low noise level, adaptable to standard size shutters. Bulletin No. 124

MASSACHUSETTS BLOWER DIVISION

The BISHOP & BABCOCK Mfg. Co.

4901 HAMILTON AVENUE CLEVELAND 14, OHIO

New
RIDGID
200
Tripod Power Drive
with
SPEED CHUCK

Light Weight...
Easily Quickly Set Up...
Built-In Folding
Tool Tray and
Folding Legs
Pats. Applied For

Power for any hand pipe tools
—⅛" to 2" pipe, ¼" to 2"
bolts; geared tools to 12".

Leg Spacing and Tool Tray
assure solid rigidity, greater strength . . . No front leg to obstruct swing of die stock handles.

Fast Easy Chucking
new principle—guaranteed to grip tight both forward and reverse, won't slip, even with geared tools . . . 3-jaw centering device turns with pipe . . . Extra-powerful motor, larger brushes, longer commutator.

Your Supply House has it—
ready to demonstrate and expedite your order.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U.S.A.

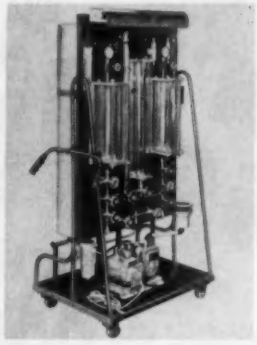
RIDGID
Work-Saver Pipe Tools

EQUIPMENT DEVELOPMENTS

Continued

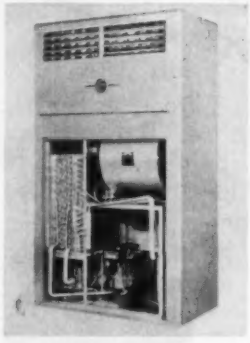
As yet, these units are not being mass produced but are being made to specifications by Wetmore Hodges & Assoc., 816 Chestnut St., Redwood City, Calif.

Portable Service Station For Evacuating, Charging



A new line of portable service stations for evacuating and charging air conditioning and refrigeration units is comprised of a high vacuum pump and motor, a bracket for holding an inverted cylinder of "Freon" and a calibrated charging board with measuring tubes isolated by valves and connected into a manifold, the manufacturer reports. The model "KC-2" pump is designed to dehydrate and degas the cooling units to facilitate design performance at the lower operating temperatures now prevalent in air conditioners, refrigerators and freezers, says the company. Kinney Mfg. Div., New York Air Brake Co., Boston 30.

Packaged Two Stage Cooling System



The manufacturer's "Double-Kool No. 30" is a self contained unit that has a cooling capacity of 5 to 7 tons using only a 3 hp compressor, the company reports. The increase in capacity is gained by first using the condenser water for precooling the entered air. The cooling system itself consists of a 4 row copper water coil and a 2 row copper "Freon" coil.

Advantages cited by the manufacturer are; compressor size is cut in half, high capacity is permitted with existing single phase power, and outdoor air is delivered on hottest days. Hastings Air Control, Inc., 3215 Leavenworth St., Omaha 5.

Plastic Treated Wood Blades For Fans

Plastic impregnated wood blades are now available on the manufacturer's 14 to 22 ft heat exchanger fans, the company announces. Introduced to supplement plastic cooling tower and heat exchanger fans, the new wood blades are designed for resistance to deterioration, according to the manufacturer.

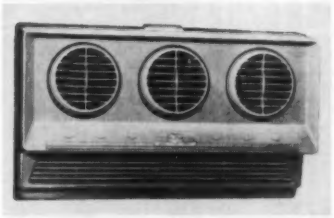
While the plastic blades are still recommended for durability and length of life, the initial cost of these wood blades is lower, the company reports. Hartzell Propeller Fan Co., Piqua, Ohio.

Lever Control For Speed Transmission

A mechanical lever control for use with the manufacturer's "Speed-Trol" variable speed transmission is a device for varying the output speed of the transmission by moving the lever through an arc, the company announces. Cited applications for this type of direct control include follower rolls, steam or pneumatic regulators, steam or hydraulic cylinders, control of conveyors, control of machine tools, and damper controls.

The "Speed-Trol" can also be equipped with a direct pickup electric tachometer, not shown. The device includes a signal generator and speed indicator. Standard calibration of the indicator is in rpm, but it can also be furnished calibrated in various units of production such as fpm and gph, the company says. Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles 22.

Self Contained Window Air Conditioning Unit



A self-contained, 2 hp window air conditioner that does not use water, is capable of cooling large office spaces, the manufacturer reports. The unit operates with twin 1 hp systems. Controls can be adjusted to run the unit with one compressor when maximum cooling is not needed, according to the company. Three diffusers on the front of the unit individually tilt up or down and rotate 360 deg to allow the user to direct air to any place in the area without creating drafts, the manufacturer says. The unit is also designed to remove moisture from the air and to filter dust and pollen particles. The O. A. Sutton Corp., 1812 W. 2nd St., Wichita 2.

Adaptable Window Air Conditioner

A universally adaptable room air conditioner designed for any type window or through-the-wall installation and one that fits to the glass line is one of a series of room air conditioners recently introduced. The "All-in-One Windowlette," as the unit is called, is a ¾ hp model that requires no alteration of window structure for installation, according to the manufacturer. Philco Corp., Tioga & C Sts., Philadelphia 34.

Independent

"Fabrikated" WALL GRILLES

REG. U. S. PAT. OFFICE

Special Sizes to Your Order

We welcome your requirements for special, large size grilles. With Independent famous "Fabrikated" construction, such grilles are rigid—strong—exceedingly resistant to impact—the best money can buy.

On all such "specials" we are prepared to give immediate service and prompt shipment, since we always stock grille parts for any size.

Send us your requirements for prices and shipping date

This special "Fabrikated" wall grille is 4' high and 2' 10" wide. We make 'em any size.

Always Leading—Always Progressing

THE INDEPENDENT REGISTER CO.

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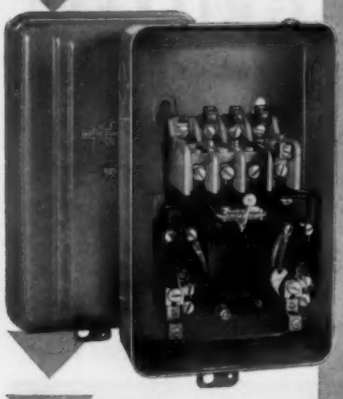
Save 3 WAYS



COST!

Save up to 25%. With the wide range of Furnas Electric starters to choose from, you don't have to waste money on starters too big for the job.

CAPACITY!

The many in-between sizes in the Furnas Electric line allow you to choose the control that is best suited for your particular job.

SPACE!

You can save up to 40%. By selecting the exact size starter for your requirements you get a starter that is more compact.

Write Today for free 140-page Catalog 101. Furnas Electric Company, 1041 McKee Street, Batavia, Illinois

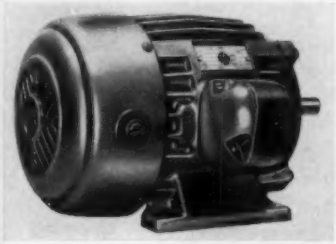
FURNAS ELECTRIC COMPANY
BATAVIA, ILLINOIS
Sales Representatives in all Principal Cities

EQUIPMENT DEVELOPMENTS
Continued

Differential Transformer For Valve Indication

A new rotary variable differential transformer is designed for the continuous measurement and remote indication of the angular position of valves and similar equipment. Schaevitz Engineering, Camden 1, N. J.

Compact Enclosed Motor To NEMA Standards



A motor for duties requiring a completely enclosed unit and conforming to the dimensional standards of NEMA has been designed more compactly than previous types and the same horsepower is provided in less space, says its manufacturer.

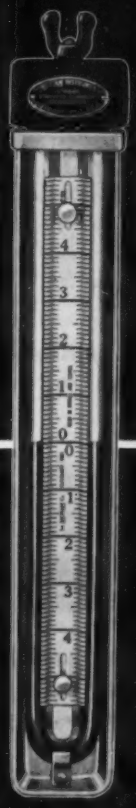
This motor, available in ratings from 1 to 10 hp, is recommended for operation where fumes, dust and moisture are prevalent, the company says. U.S. Electrical Motors, Inc., Box 2058, Los Angeles 54.

Evaporative Condenser Features Turbulator

The heart of the new "Aqua-Fog" evaporative condensing unit is the "Carraway Turbulator," designed to make possible rapid heat transfer and make practical the use of small evaporative condensers by replacing

UNMATCHED ACCURACY

with simplicity and economy



AT LOWEST COST . . . this Meriam Manometer offers high accuracy. The Meriam B-1103 is the easy-to-use, always dependable form of pressure or flow instrumentation. Pressures to small fractions of an ounce are read directly, accurately . . . without calibration or instrument adjustment . . . with complete enduring manometer reliability.

★ Rugged cast alloy construction

★ Convenient manometer cleanout

★ Curved scale for increased readability

★ Designed for easy panel mounting

Write for Bulletin C-12.

Meriam Manometer Instrumentation
...for pressures, vacuums, flows, liquid levels.

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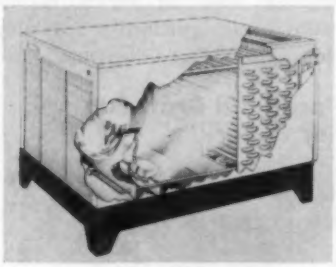
INSTRUMENT COMPANY
10920 Madison Ave. • Cleveland 2, Ohio

EQUIPMENT DEVELOPMENTS
Continued

conventional spray nozzles, trickle pans, or slotted tubes, according to the manufacturer.



The spinning action of the "Turbulator's" dual wheels lifts the water and breaks it into multiple sprays, the company reports. As the water is broken into a fog, a fan forces air over the condenser coils that are carrying hot refrigerant from the compressor. This rapid heat transfer is effected by reducing the temperature in the fog chamber to a close proximity of the wet bulb temperature of the surrounding atmosphere, says the manufacturer. The excess water is removed from the exhaust air stream and returned to the water pan by a moisture eliminator. Cobell Industries, Inc., P.O. Box 1157, Ft. Worth 1.

Rectifier Arc Welder With Remote Control

A new 300 amp d-c selenium rectifier type arc welder with remote control has a 5 range control switch to permit coarse adjustment with generous overlap between ranges to provide dual control, the company announces.

The rheostat, which can be removed for remote control, provides continuous control by adjusting the direct current through the control coils, according to the manufacturer.

PHOSON-0 PHOSON-6

These Two *United* Alloys

...for All Your Copper and Brass Joining!

Tubular Assemblies
Stampings
Screw Machine Parts
Electrical Connections
etc.

PHOSON-0 (No Silver!)

Industry's most popular alloy choice for brazing closely fitted copper and brass joints where exceptionally low temperature is not an important consideration.

Highly Efficient! Most Economical!

Use Phoson-O for brazing joints of consistently uniform clearances — quickly, safely, surely!

PHOSON-6 (6% Silver)

For really low temperature brazing and complete control of alloy flow . . . where maximum ductility and varying joint tolerances are key factors.

PHOSON-O (No Silver!) PHOSON-6 (6% Silver)

These Two Alloys For All Your Copper and Brass Joining!

Two Good Reasons Why PHOSON BRAZING ALLOYS Are Busier Than Any Brazing Alloys In The Country!

Wherever Metals Are Joined, Keep Them — Permanently United

UNITED WIRE
AND SUPPLY CORP.
Brazing Alloy Division
PROVIDENCE 7, R. I. • OFFICES IN PRINCIPAL CITIES
← *Send for special PHOSON folder NOW!* ———

Los Angeles County Engineers Building
SAVES $13,300 in AIR CONDITIONING with KOOLSHADE SUNSCREEN

Problem: The Los Angeles County Engineers Building was to be air conditioned. The building was equipped with Venetian blinds, but the engineers investigated several other window-shading devices in search for one that would do a better job of cutting air conditioning requirements.

Solution: Tests proved that solar heat transmission through the blinds—even when tightly closed—amounted to 1,102,000 BTU's. With KoolShade, only 232,000 BTU's. In refrigeration requirements, the difference amounted to 72 tons! Costwise, this reduction in tonnage adds up to a net saving of $13,300 over and above the cost of the KoolShade . . . and to this must be added the substantial annual savings from lower operation and maintenance of the cooling equipment.

By keeping the heat and glare of the sun *outside* the building, KoolShade Sunscreen eliminates hot spots and excessive loads . . . provides a balanced and trouble-free installation.

Only KoolShade Sunscreen offers

- **unsurpassed shading efficiency**—keeps up to 87% of the sun's rays off windows during the hottest part of the day—100 sq. feet of KoolShade reduces air conditioning load 1 ton.
- **80% clear visibility**—admits maximum glareless light.
- **harmony with all architecture**—improves building's appearance.
- **virtually no maintenance**—constructed of strong preoxidized bronze strips, wired and framed together, lasts for years, withstands hard blows.

Send today

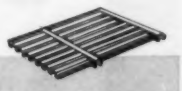
for this detailed and illustrated bulletin. And for expert help in cutting costs and sun problems, just request a call from a KoolShade engineer. No obligation or charge.

Distributor franchise still open in many communities for those who qualify.

KOOLSHADE Sunscreen

REFLECTAL CORPORATION
A subsidiary of Borg-Warner Corp.
310 S. Michigan Ave., Suite 2823, Chicago 4, Ill.

ALFOL INSULATION

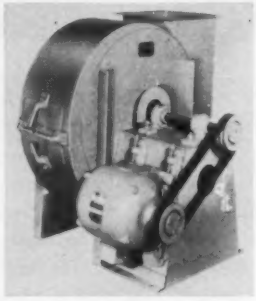


INGERSOLL ROOF DECK

EQUIPMENT DEVELOPMENTS
Continued

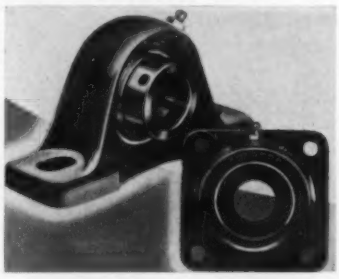
These controls are designed to provide a welding current range of 35 to 425 amp for use with a variety of electrode sizes for repair, maintenance and production welding. Hobart Bros. Co., Troy, Ohio.

Packaged Draft Fan For Boilers



Available as a packaged unit ready for installation, the company's induced draft fan includes fan, motor, motor base and adjustable speed v belt drive, the manufacturer reports. Units are designed to meet boiler requirements ranging from 3500 to 50,000 EDR. Chicago Blower Corp., 9867 Pacific Ave., Franklin Park, Ill.

Ball Bearing Pillow Blocks and Flanges



The manufacturer's "SP" series, a new line of ball bearing pillow blocks and flanges, incorporates new features which result in greater bearing capacity, increased alignment range, and greater interchangeability, according to the company.

Included among the improvements are a reinforced housing, improved shaft lock, and dustproof seals, the manufacturer says. Blocks and flanges are made in shaft sizes from 3/4 to 2 15/16 in. Ahlberg Bearing Co., 3025 W. 47th St., Chicago 32.

FAMOUS LAST WORDS:

"they wouldn't dare"

That's what they said the day before Pearl Harbor. Remember? But by now you'd think people would have learned. Let's face it—we must be ready for disaster at any moment. It may be an atom bomb—or it may be a fire, a flood, a hurricane. It's only common sense to be prepared for it, whatever it is. Take these precautions TODAY:

- ☐ **Enlist the help** of your local Civil Defense Director.
- ☐ **Check contents** and locations of first-aid kits.
- ☐ **Send staff** to Red Cross courses. They may save your life.
- ☐ **Promote preparedness** in your community. Your local CD Director can show you how.

Set the standard of preparedness in your plant city—check off these four simple points NOW.

CONTRACTORS saving hundreds of Installation Dollars with FEDDERS *Beauty Base Heat* BASEBOARD RADIATION

● Check every Fedders feature listed at right. See how and why contractors are cutting installation costs to the bone! Amazing savings in time and dollars are being reported from job after job. We can tell you,—but order Fedders Beauty Base Heat Baseboard Radiation, and make your own cost records convince you.

1. Integral top and back— SAVES TIME!
2. Factory assembled, adjustable deflector-type dampers— SAVES TIME!
3. Strong rigid element brackets assembled at factory— SAVES TIME!
4. Copper element tube end expanded for quick installation— SAVES TIME!
5. Indented self-centering "hole starts" for nails— SAVES TIME!
6. Snap-on cradle support for element allows ample expansion— SAVES TIME!
7. Front cover *Snaps on*— SAVES TIME!
8. Choice of aluminum-finned copper tube or steel-finned steel tube.

I-B-R APPROVED RATINGS

Reg. U. S. Pat. Off.

FEDDERS-QUIGAN CORPORATION

Heating Division Trenton 7, N. J.

EQUIPMENT DEVELOPMENTS

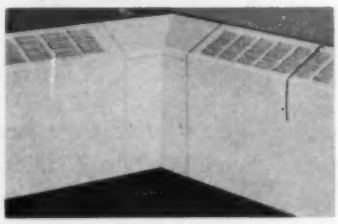
Continued

Insulation For Lines To Air Conditioners

"Armaflex," a new foamed plastic insulation for use on dual temperature lines to air conditioning units, can be slipped onto pipes or tubing when the system is installed, the company reports. Since it is a closed cell foam, resistant to the passage of vapors and air, it requires no vapor barrier, according to the manufacturer.

If the lines have been connected and tested, it can be cut to the desired length, slit longitudinally, snapped on the line and the slit sealed with an adhesive which is available with the material, says the manufacturer. When the tubing is covered, the insulation takes the shape of the pipe bend. Armstrong Cork Co., 4400 Concord St., Lancaster, Pa.

Convector Radiators For Rooms, Corridors



Designed for application where heating requirements demand installation under rows of windows and other layouts encountered in large rooms and corridors, the manufacturer's new line of continuous convector radiators are self contained and have a sloping top to prevent the cabinet from being used as a seat or shelf, the company announces.

Adjacent cabinets have interlocking fronts which present a smooth appearance without necessity for join-

EQUIPMENT DEVELOPMENTS
Continued

ing strips, says the manufacturer. Base grilles at bottom for inlet air are available. Fedders-Quigan Corp., Heating Div., Lalor and Hancock Sts., Trenton 7.

Psychrometer For Field Service

A new psychrometer, designed for field service application, measures percent relative humidity by wet and dry bulb temperature readings, says the company. Its two thermometers are mounted in a plastic case which telescopes into a plastic handle holder. The wick of the wet bulb thermometer leads into a water reservoir at the end of the thermometer case. This feature is designed to eliminate errors due to lack of wetting.

Thermometer case and holder are connected by a swivel assembly which makes possible whirling of the thermometers freely with the handle held upright, according to the manufacturer. Bacharach Industrial Instrument Co., 7301 Penn Ave., Pittsburgh 8.

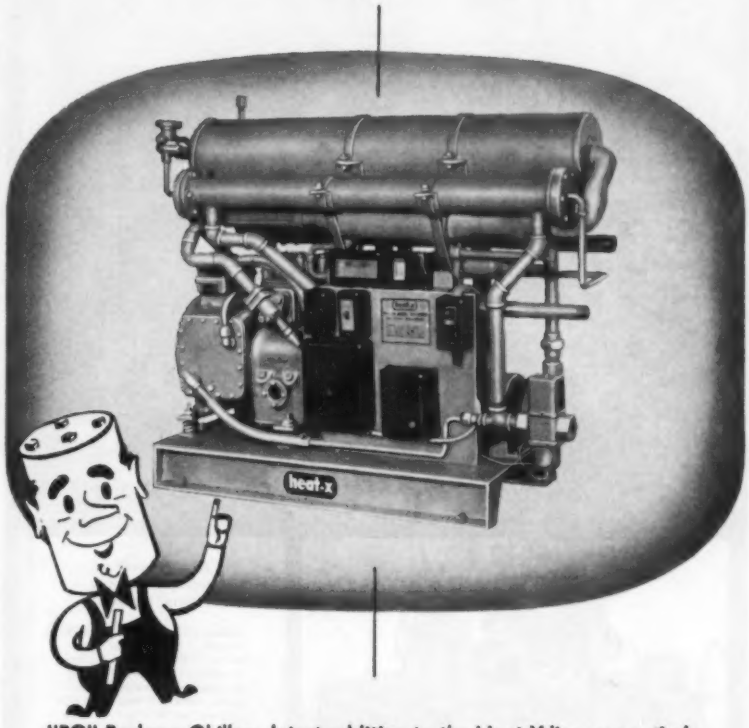
Packaged Commercial Air Conditioners

A new line of packaged commercial conditioners of improved design is available in models ranging from 2 to 7½ hp, air and water cooled, the manufacturer announces.

The unit consists of a plenum chamber engineered for proper air distribution, a blower section for air delivery, and the "Slide-A-Way" hermetic cooling system. This "Slide-A-Way" feature permits sliding the chassis out from the cabinet for servicing, according to the company. Mitchell Mfg. Co., 2525 N. Clybourn Ave., Chicago.

ANOTHER HEAT-X FIRST...

"PC" Units with ALL COPPER Water Chillers



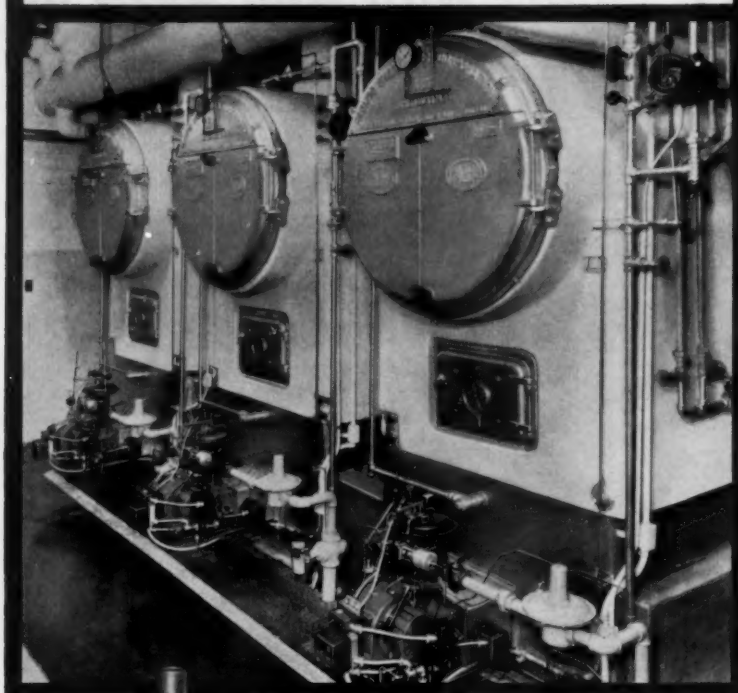
"PC" Package Chillers, latest addition to the Heat-X line, are entirely self-contained . . . delivered completely wired and charged with Freon-12 . . . ready for plug-in operation.

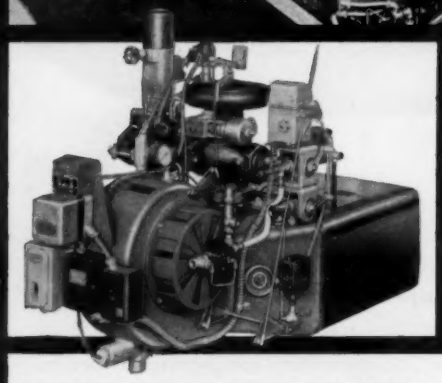
All refrigerant passages are of INNER-FIN construction . . . a patented Heat-X exclusive . . . permitting compactness of design, efficiency of operation impossible with old style construction of other chillers.

These reliable, economical Heat-X Package Chillers, available in 2 HP. through 15 HP. models, are ideal for chilled water air conditioning systems, drinking water or beverage cooling applications, industrial water cooling uses.

HEAT-X, Inc. BREWSTER, • NEW YORK

Reports 33% fuel saving from Mettler "FAN-AIR" burners





Why consulting engineers specify Mettler Burners

Change fuels easily, with remote, manual, or automatic control . . . lifetime integrated multi-port combustion tile provides complete, efficient fuel burning . . . exchange of gas orifices gives wide capacity range . . . exclusive pilot rectification control system assures safer combustion . . . give flexible operation with mechanical or natural draft.

Conversion of three boilers using "FAN-AIR" Dual Fuel Burners produced a sizeable three-way saving! In addition to 33% reduction in gas consumption, boiler maintenance has been reduced greatly because complete combustion keeps the fire-tubes clean. The boiler room is cleaner, too, and firebrick spalling and cracking has been eliminated. Modulating fuel control minimizes temperature fluctuations and adds years of life to the furnaces. These are results you can expect from "FAN-AIR" Dual Fuel Burners . . . results that win customers and influence sales *for you*. Range of sizes from 25 to 500 horsepower, for any grade of gas or oil fuel. Write for specifications and descriptive Bulletin No. 12-S.

METTLER

Eclipse

THE METTLER CO., INC.

Division of ECLIPSE FUEL ENGINEERING CO.

4366 Worth Street, Los Angeles 63, Cal.

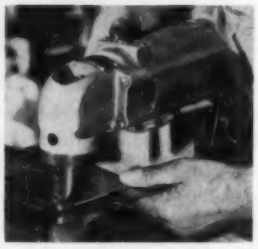
EQUIPMENT DEVELOPMENTS

Continued

New Line of Room Air Conditioners

The manufacturer's new line of room air conditioners includes 1/3, 1/2, 3/4, and 1 hp window models, 1 and 1 1/2 hp air cooled console models, and a 1 hp water cooled console model, the company reports. These "hideaway" models provide a wide flexibility of installation, says the manufacturer. Carrier Corp., 300 S. Geddes St., Syracuse 1.

Nibbler For Cutting Stainless Steel



A new light duty nibbler is said to cut stainless steel up to 18 gage, milder steel and other sheet stock up to 16 gage. The manufacturer says it is especially useful for cutting irregular, rounded, or special shapes.

Using a punch and die action, the unit removes a tiny slug of metal with each cutting stroke—leaving clean cuts without distortion, burrs, or elongation on either side, according to the company. Fenway Machine Co., 263 N. 23rd St., Philadelphia.

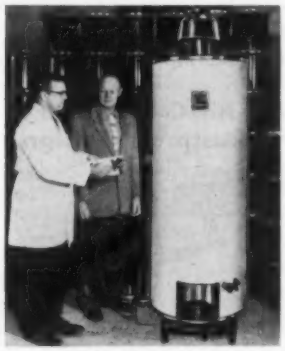
Plastic Cylinder For Moisture Separator

A clear plastic cylinder has been added to the company's line of com-

pressed air "Sta-Dri" oil and moisture separators, the manufacturer announces. The cylinder walls are of a ¼ in. thickness and are said to withstand pressures exceeding 600 lb.

The purpose of the transparent cylinder is to show when the filter elements should be replaced or when the moisture should be drained from the bottom of the separator, the company says. The cylinder is recommended by the manufacturer for use where the greatest degree of air cleanliness and dryness is essential. Beach Precision Parts Co., 120 Mechanic St., Boonton, N.J.

Booster For Water Heater



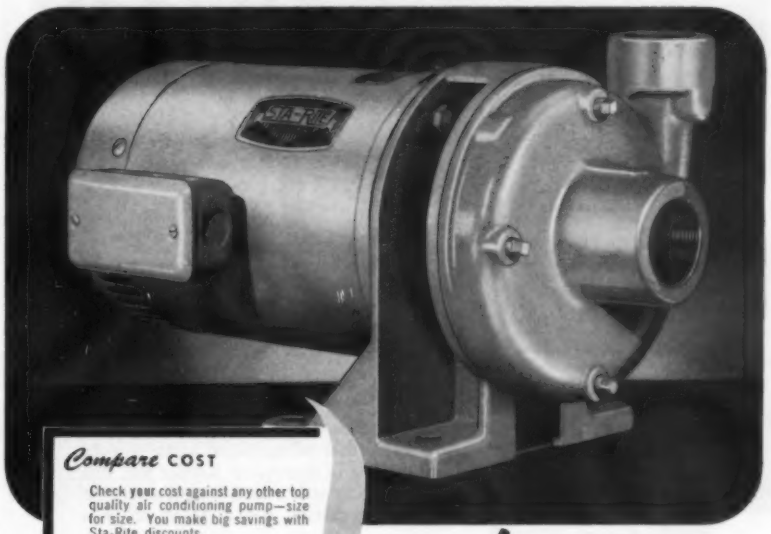
Engineering improvements in a new "Super-Hi Booster" water heater, designed for commercial users, result in the delivery of 294 gph of hot water, according to its manufacturer.

Primarily intended for large users of hot water such as industrial plants, hospitals, hotels, restaurants, apartment buildings and swimming pools, the unit may also be used as a storage tank in combination with a standard or booster heater, says the company. The booster is insulated to prevent heat loss and is equipped with "fail safe" controls, the manufacturer states. Pioneer Water Heater Corp., 3131 San Fernando Rd., Los Angeles.

Self Contained Pressure Pilot

A new pressure pilot, featuring a self contained controlled pressure gage, is designed to provide a full

Compare STA-RITE
AIR CONDITIONING PUMPS
with all others!



Compare COST
Check your cost against any other top quality air conditioning pump—size for size. You make big savings with Sta-Rite discounts.

Compare GALLONS OF WATER DELIVERED
Check TDH and efficiency, too. You get top hydraulic performance . . . more water with less power.

Compare EASE OF INSTALLATION
This pump is smaller, lighter in weight. Discharge outlet rotates to any of 4 positions. Mounting foot also rotates. Pump mounts at any angle for easy coupling and alignment.

Compare LONG LIFE
This trouble-free pump is constructed of top-quality materials, custom-engineered to assure long, dependable service. It eliminates service call backs, lets you keep your profits.

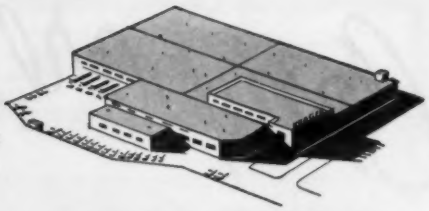
Yes, Compare
and you'll buy
STA-RITE

If you need small, lightweight pumps to fit modern, compact air conditioning equipment, check Sta-Rite. You can see pump superiority in the all-bronze closed impeller. And special 2-piece impeller construction assures friction-free channels, more capacity. Motors are full power, ball-bearing and capacitor-type, specially designed and made only for Sta-Rite pumps. Mechanical seal is positive, leak-proof. Single shaft is corrosion-resistant, requires no coupling, prevents alignment problems.

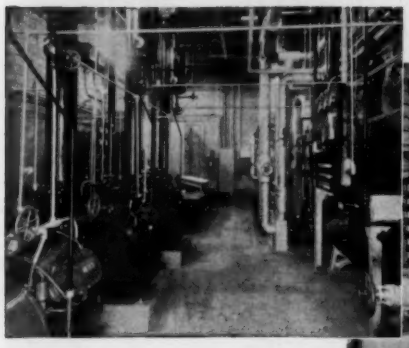
Ask your wholesaler, or write for his name and a copy of new bulletin describing Sta-Rite Air Conditioning Pumps.

STA-RITE PRODUCTS, INC.
305 S. EIGHTH ST. • DELAVAN, WISCONSIN
Los Angeles, Calif. • Chamblee, Ga.
In Canada: STA-RITE Pumps (Canada) Ltd., Ajax, Ontario

Kroger



uses complete VILTER INSTALLATION



The modern new Kroger Company warehouse in Charleston, West Virginia is equipped completely with Vilter refrigeration units—a vote of confidence in Vilter refrigeration. As in a previous Kroger job, this new refrigeration system started operation with a minimum of attention and adjustment . . . a real blessing in getting a new plant off to a "flying" start.

This well-engineered installation consists of three VMC ammonia compressors, each selected for a definite temperature condition and cross-connected for flexibility. The freezer compressor, air conditioning compressor, and storage room compressor of 25, 40, and 50 h.p. sizes balance the specific load requirements of the various sections of the warehouse—including the Banana rooms, dry produce room, wet produce room, dairy cooler, and meat cooler. In addition to the compressors, there are Vilter brine spray-type air units, suction accumulators, evaporative condensers, and controls to complete this custom designed refrigeration installation. Vilter supplied the "complete refrigeration package" . . . thereby simplifying installation, operation, and maintenance problems.

Vilter understands how to design refrigeration systems to meet the specific needs of the job. That's why Vilter not only provides you with the "right" refrigeration . . . but knows how to cut down on the amount of costly space and also lower installation and operation costs. Furthermore, "among the men who know," Vilter has earned recognition as having a refrigeration system that keeps on running day in and day out—protecting your investment in meats, food, and produce—and doing so at lower operating and maintenance costs!

Vilter gives you a well-engineered product and a well-engineered installation. For dollar saving ideas and "top" refrigeration equipment consult your nearest Vilter representative.

Vilter

Your nearby Vilter Representative or Distributor will be glad to show how Vilter refrigeration can help you.

REFRIGERATION and AIR CONDITIONING

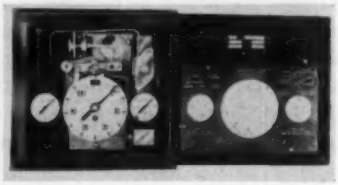
THE VILTER MANUFACTURING COMPANY, MILWAUKEE 7, WIS.

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water and Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice and Polarflake Ice Machines

EQUIPMENT DEVELOPMENTS

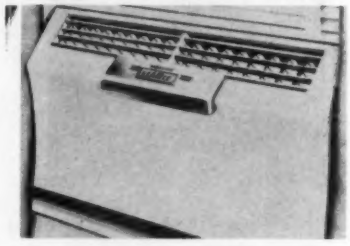
Continued

range of control operations in a single standardized unit, its manufacturer announces. Changing from proportional to differential gap control or from direct to reverse action involves shifting the turret type nozzle from one preset position to another, the company says.



Features cited for the unit include an all metal relay, pneumatic feedback synchronization, full dampening controls for surge pressures and a sapphire feed orifice with pushbutton cleaner. Kieley & Mueller, Inc., 108 Genung St., Middletown, N. Y.

Room Air Conditioner With Rustproof Design



To a new window type room air conditioner featuring corrosionproof construction, the manufacturer has added an aluminum base pan and other structural parts of aluminum to its otherwise all glass fiber unit, the company announces. The units will be produced in ten models of ½, ¾ and 1 ton cooling capacities.

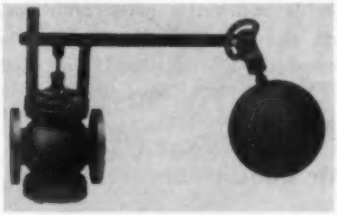
In addition to units featuring electric strip heating and reverse cycle heat pump operation, the company says it will also offer lower cost "Standard" models designed for the institutional user. United States Air Conditioning Corp., 3300 Como Ave., S.E., Minneapolis 14.

New Float Valve For Liquid Level Control

A new float type valve for controlling levels of liquids in many in-

EQUIPMENT DEVELOPMENTS
Continued

dustrial operations such as air conditioning installations, power plants,



textile mills, water works, breweries, chemical plants, and other industries, is designed to maintain the level in open storage tanks, process tanks, spray ponds, cooling tower basins and similar liquid reservoirs, the manufacturer reports.

This direct acting control, called the No. "1620" series float valve, is constructed mainly of bronze and steel. Floats of other metals for special applications are available, the company says. The valve is available in eleven sizes from ¼ to 4 in. Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Box 400, Knoxville.

Manual Starter For Fractional HP Motors

A new manual motor starter designed to provide across-the-line starting as well as overload protection for fractional horsepower motors is operated by means of an *on* and *off* standard type toggle lever, the company reports. The toggle is engineered to be positive acting and to produce quick make and break contacts, says the manufacturer.

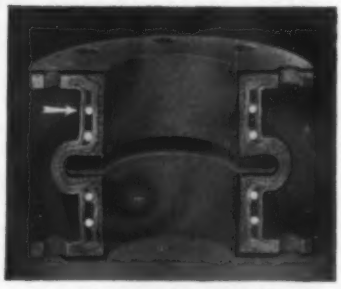
The starter has straight through wiring with line terminals at the top and load terminals at the bottom, all identified by terminal markings molded into the base. An alloy thermal overload relay with inverse

- ABSORB VIBRATION
- ELIMINATE NOISE
- REDUCE HAMMER BLOW CAUSED BY PRESSURE SURGES
- PREVENT FLANGE BREAKAGE
- CORRECT PIPING MISALIGNMENT

Expansion joints in operation on 2½" suction and discharge pipes.

Garlock rubber expansion joints will stand up under repeated flexing. They are constructed of high grade rubber which is combined with plies of sturdy cotton duck and reinforced with steel rings.

These flexible joints are used in air conditioning and water lines in commercial and institutional buildings and industrial plants to prevent transmission of sound and to absorb vibration, thus saving wear and tear on the pipe flanges. They are made for all pipe sizes ¾" to 72". Write today for Rubber Expansion Joint Folder, AD-137.



Sectional view shows sturdy construction of single arch joint. Arrow points to one of steel reinforcing rings.

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago Cincinnati • Cleveland • Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N.Y.) • Philadelphia • Pittsburgh • Portland (Oregon) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK

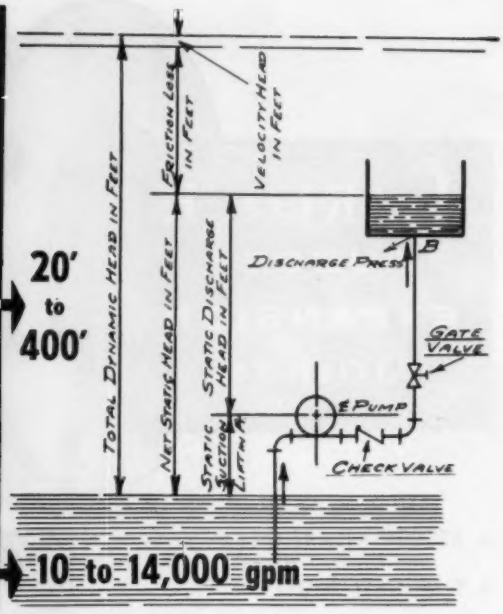
PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS, RUBBER EXPANSION JOINTS

NAME YOUR HEAD

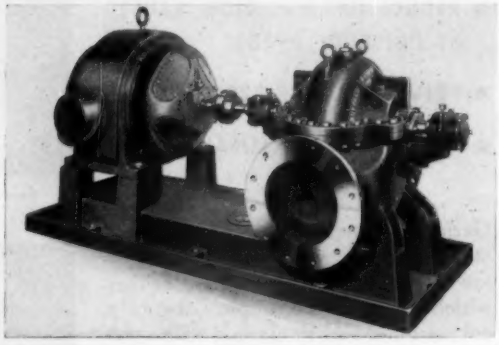
20' to 400'

NAME YOUR VOLUME

10 to 14,000 gpm



THERE'S A "BUFFALO" DOUBLE SUCTION PUMP FOR HIGHEST EFFICIENCY



"Buffalo" Type "SL" Double Suction Pump. Write for Bulletin 955-P for all details.

If you wish to move large volumes of clear water at heads up to 400', this Type SL Double Suction Pump is your ideal choice. It offers you:

(1) The finest construction, embodying the best accepted pump engineering features—the famous "Q" Factor*.

(2) Such a wide range of sizes (1½" to 20" pumps) that you can very accurately select the most efficient pump from its performance curve.

In addition to these pumps, "Buffalo" builds single suction, single stage and multistage centrifugal pumps for every type of service. We shall be happy to supply you with details on any of these lines—all backed by 78 years of quality pump manufacturing.

"Buffalo" PUMPS

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO PUMPS, INC.

171 MORTIMER STREET BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

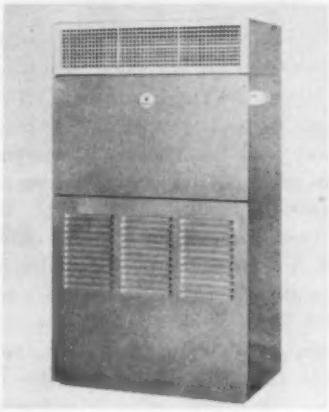
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

EQUIPMENT DEVELOPMENTS

Continued

time limit features is incorporated into the unit and it is offered in both double and single poles, both open and closed types, according to the company. Cutler-Hammer, Inc., 315 N. 12th St., Milwaukee 1.

5 Ton Packaged Air Conditioner



A new 5 ton, completely packaged air conditioner is self contained, but is also available without plenum and fan for use with existing heating systems, the manufacturer reports. It also can be equipped with steam coils.

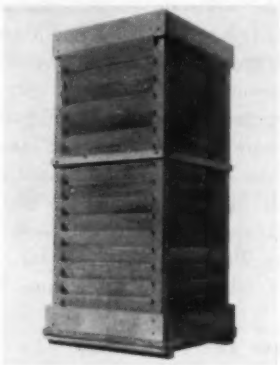
The units feature 1 and 3 phase hermetic compressors, counterflow cleanable type condensers, aluminum fin evaporators with copper tube, capillary system, and new cooling and heating type switch controls suitable for remote installation and use with standard thermostats, according to the company. Aug. G. Barkow Mfg. Co., Inc., 2230 S. 43rd St., Milwaukee 15.

Packaged Atmospheric Cooling Towers

A new series of atmospheric cooling towers have ratings from 3 to 50 tons and are constructed of very dry, clear, or select heart redwood, the company announces. Basin floors are shipped preassembled, with all holes drilled, so that no drilling or nailing is required on the job, says the company. Towers are complete with plated hardware, suction connection and screen, drain hole with plug,

EQUIPMENT DEVELOPMENTS
Continued

bronze float valve assembly, and galvanized steel spray headers.



Featured with the tower are butyrate spray nozzles, which are designed for water breakup at low pressures. Thermal Agency, 1515 Dallas, Houston 3.

7 1/2 HP Air Cooled Condensing Unit

Model "1208," a new 7 ½ hp waterless air cooled condensing unit, is self contained and enclosed in a "Bonderized" cabinet, permitting basement, utility room, outdoor, roof or other installation, according to its manufacturer.

It is also designed for use with various of the company's evaporator coil or evaporator blower units. Airtemp Div., Chrysler Corp., 1600 Webster St., Dayton 1.

Electrode For Welding High Alloy Steels

A new electrode for welding high alloy steels can be work hardened to over 180,000 psi tensile strength, its manufacturer states. It is an alloy of chromium and nickel and may be

cut your
field erection costs
with complete hanger units

A sure way to cut your field erection costs is to use Blaw-Knox hangers and eliminators. Each is a complete packaged unit, ready to install. No expensive cutting, threading and assembling on the job.

In addition, these packaged units will cut your engineering and specifying time.

Each Blaw-Knox functional spring hanger, constant support spring hanger, rigid hanger assembly, overhead roller assembly, and vibration eliminator is designed for a specific purpose. Constructed to conform with the "code for pressure piping." Available in types and sizes to meet varying conditions.

Whenever you'd like some help, our experienced engineers are available to both design and make recommendations for your hanger requirements.

BLAW-KNOX COMPANY
Power Piping and Sprinkler Division
Pittsburgh 33, Pennsylvania

To get complete information, send for your copy of Bulletin 54.

BLAW-KNOX **PIPE HANGERS**

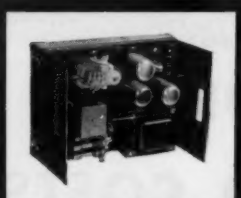
Complete line of functional spring hangers • constant support spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators . . . plus complete prefabricated piping systems for all pressures and temperatures

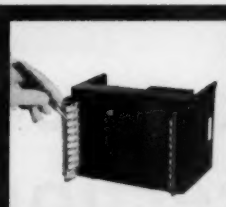
BARBER COLMAN

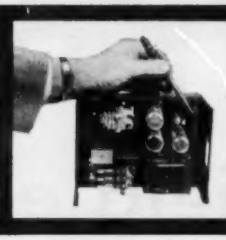
New Wheelco Combustion Safeguard

stops trouble-shooting before it starts!

For oil- and gas-fired furnaces, ovens, boilers, kilns, and dryers.







For better engineered, safer, and more serviceable heating installations, the new Wheelco Flame-otrol gives you all the design features so critically needed *today!* The compact "plug-in" chassis, design-pioneered by Wheelco, offers complete accessibility for adjustment, examination, and repair. Exclusive, new terminal strip assures constant, uniform separation contact pressure and facilitates removal of the chassis. Convenient external test points simplify circuit and voltage checking. Standard electronic tubes are quickly and easily replaced at minimum cost. These are features that eliminate trouble calls and build satisfied customers. Your Wheelco Field Engineer can give you expert help in designing, installing, and servicing better combustion safeguard systems.

WRITE FOR SPECIFICATIONS

Bulletin F-6570 describes infrared, conductivity-rectification, and simple conductivity sensing systems available for complete flame supervision under all conditions. Explains Wheelco's comprehensive "safe-start" circuit for both *manual* and *automatic* Flame-otrols, plus information on pre-wired Control Centers.

WHEELCO INSTRUMENTS DIVISION

Barber-Colman Company

Dept. P, 1501 Rock Street, Rockford, Illinois
BARBER-COLMAN OF CANADA, LTD., DEPT. P, TORONTO, ONTARIO, CANADA
Industrial Instruments • Automatic Controls • Air Distribution Products • Aircraft Controls • Small Motors
Overdoors and Operators • Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

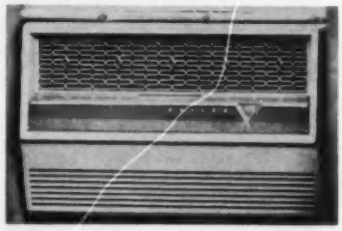
EQUIPMENT DEVELOPMENTS

Continued

used with either a-c or d-c welders, according to the company.

The electrode is particularly designed for steel parts subjected to high heat, impact and corrosion, and is recommended for use on very high alloy steels, tool steel, spring steels, pressure vessels, mild and medium carbon steels, and air hardenable steels. It is available in 3/32, 1/8, 5/32 and 3/16 in. core sizes. All-State Welding Alloys Co., Inc., 249-55 Ferris Ave., White Plains, N. Y.

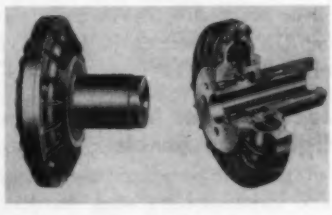
New Features For Air Conditioner



Shown is the manufacturer's model "105-M" 1 hp room air conditioner designed with pushbutton controls and automatic temperature control. The unit is one of eight new models, all featuring adjustable window mounting, the company reports.

Other units will also feature a reverse cycle heat pump that will heat the same size rooms that they cool, according to the manufacturer. Another feature is the "Comfortimer" which is engineered to permit operation of the air conditioner at specific intervals up to a lapsed time of two days. Philco Corp., Tioga and C Sts., Philadelphia 34.

Dry Fluid Drive Power Transmission



"Flexidyne" dry fluid drive, a new industrial power transmission, is designed to handle difficult starting and

BARBER COLMAN

ELECTRIC

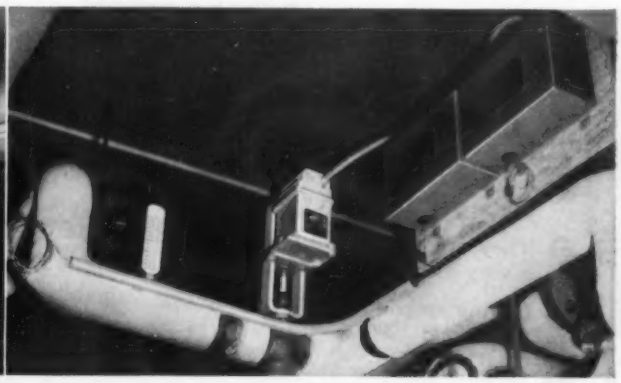
Automatic Controls

at Wisconsin Bell, it's "better control . . . electrically"

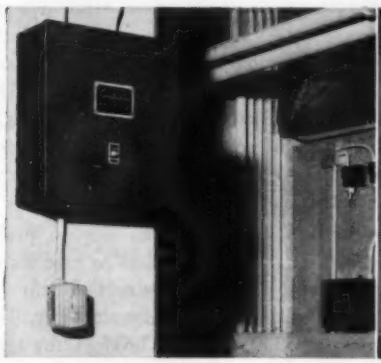
Telephone engineers, keenly aware of speed, accuracy, and dependability of electrical equipment, are using electric-electronic controls for heating, ventilating, cooling, and humidifying their buildings. New structures, additions, and modernized exchanges are getting *"better* control . . . electrically" as the telephone industry's huge expansion program moves ahead. Here, in Beloit, Wisconsin, is a typical all-electric installation, utilizing the very latest in control developments to guard sensitive telephone equipment from moisture damage, plus providing indoor comfort for employees and visitors. Similar systems are being installed in exchanges throughout the nation.

Architects: GRASSOLD-JOHNSON & ASSOCIATES. *Consulting Engineer:* JOSEPH H. VOLK (deceased). *Heating & Ventilating Contractor:* THOS. E. HOYE HEATING CO. *Sheet Metal Contractor:* LOUIS HOFFMAN CO., INC.— all from Milwaukee, Wisconsin.

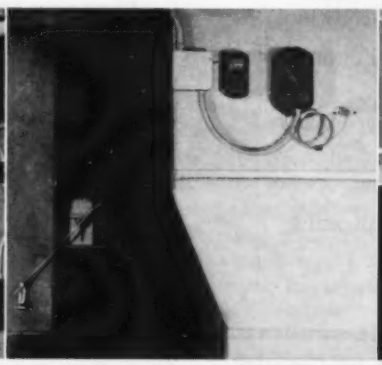
Attractive, modern offices — electric controls provide comfortable atmospheric conditions which encourage continuing employment, clerical accuracy. Desired temperature and humidity are maintained "on the nose."



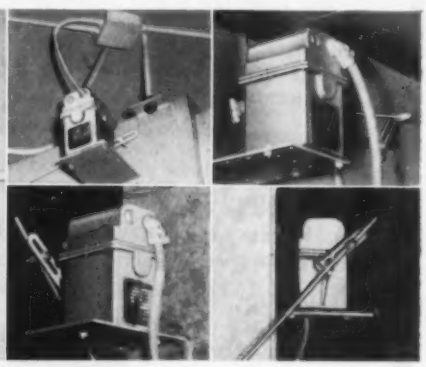
Adjustable ratio outdoor reset controls in cabinets actuate two 3-way valves. One valve controls water temperature for ceiling panel heating system. Other valve controls temperature for hot water radiation system.



Control Center cabinet serves as central junction box, houses prewired accessories, numbered terminal strips. Humidity control panel at right.



Remote bulb Microtherm on return air duct, operates proportioning valve on coil. Damper motor (left) positions return air damper.



Dependable, powerful, electrically operated Control Motors provide positive positioning of dampers in supply and return air ducts.

Flexibility and economy of electric-electronic control systems are well illustrated in this application. Two outdoor reset control systems assure maintenance of even, comfortable temperatures inside, with minimum waste of heat. One system controls ceiling panel heating, the other, hot water radiation. A small overhead heating unit in the basement has its own set of controls. Ventilating equipment and humidifiers are likewise equipped with individual control systems. Availability of power lines throughout the building simplified installation, decreased costs.

Every building, large or small, can be provided with similar flexibility and reliability at costs often lower than anticipated.

Check with your nearby Barber-Colman Field Office (consult phone directory) for expert engineering counsel, latest literature, and prices. Join the modern trend to *"better* control . . . electrically!"

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Dept. P, 1301 Rock Street, ROCKFORD, ILLINOIS, U. S. A.

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Automatic Controls • Air Distribution Products • Industrial Instruments
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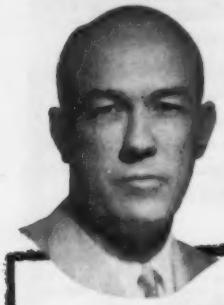
Architect Stanley Brown, A.I.A. gives

10 Good Reasons



why he specifies

Janitrol

Since 1945, Mr. Brown of Dallas has designed over 50 school buildings, all using Janitrol Gas-Fired Unit Heaters, here are his reasons . . .

1. Janitrol units have met with the approval of every client.
2. They are economical in first cost and require a very minimum of maintenance.
3. Ceiling suspended, they occupy no valuable floor area.
4. Installation provides absolute safety for school children.
5. Thermostat control assures good heat at the right place and at the proper time regardless of outside weather conditions.
6. Blower fan is often used as air circulator in summer.
7. Classrooms can be heated very quickly.
8. Forced-air heat gives a good distribution of warm temperatures.
9. Heaters are compact, with a pleasing appearance.
10. Janitrol Unit Heaters have been satisfactory in every way and the service given by your distributors has been excellent.

Janitrol
GAS-FIRED UNIT HEATERS

Janitrol Heating & Air Conditioning Division
Surface Combustion Corporation
Columbus 16, Ohio
In Canada: Alvar Simpson Ltd.
Toronto 13

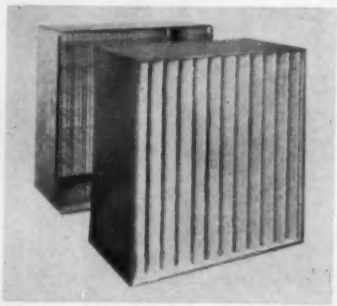
ALSO MAKERS OF *Surface* INDUSTRIAL FURNACES *Kathabar* HUMIDITY CONDITIONING

EQUIPMENT DEVELOPMENTS

Continued

reversing problems and give protection against shock and overloads. The drive is made up of a housing, inside of which a rotor is free to turn concentrically. Between the two are fine particles of spherical steel shot, called the "flow charge," which acts like a fluid, the company reports. This charge transmits power from the housing to the rotor. Dodge Mfg. Corp., Mishawaka, Ind.

Commercial, Industrial High Efficiency Air Filter



The "Aerosolve" air filter is designed to provide high efficiency filtering in industrial and commercial applications. The filter is being used by the Atomic Energy Commission for removal of radioactive particles and by industry where a high degree of clean air is required, the manufacturer states. Cambridge Filter Corp., 738 Erie Blvd., E., Syracuse.

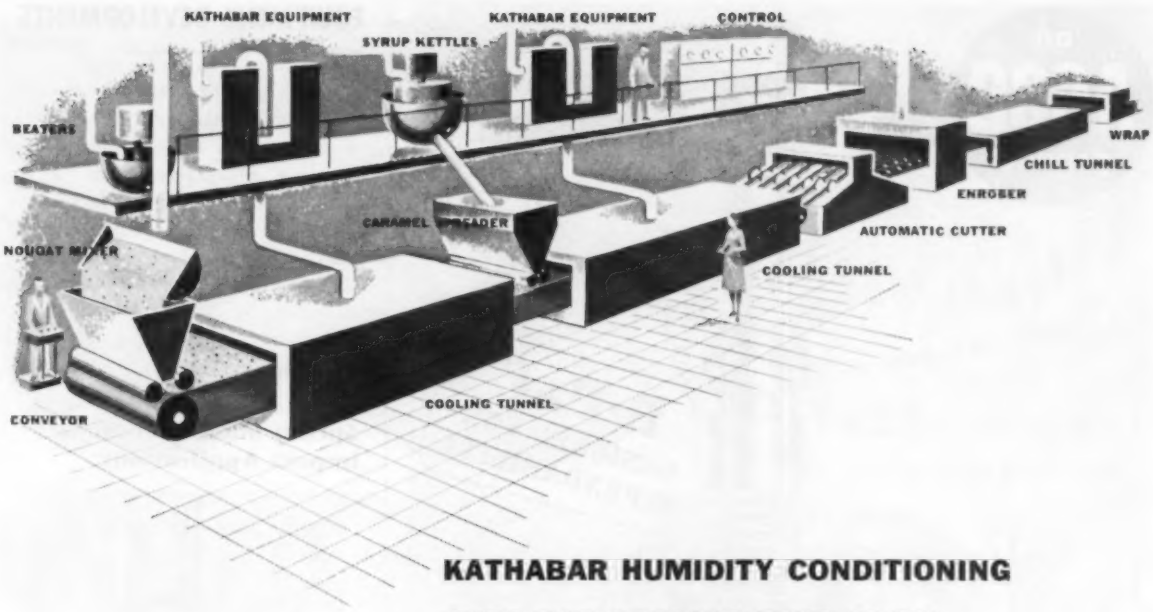
Chemical Feed Control With Liquid Level Alarm

Combining control with a liquid level alarm, a complete chemical feed control apparatus can be used to regulate flow in any situation in which it is necessary to feed liquid chemicals, the manufacturer states. The total time cycle, that of the chemical fed and the length of non-feeding time, can be set so that they will proceed automatically until chemical supply is exhausted or a new setting is decided upon, says the company.

The liquid level alarm consists of an electric probe in the chemical tank, set at such a level as to give warning in ample time to allow the tank to be refilled before it empties completely, according to the manufacturer. The warning bell begins to sound when the level in any tank falls below the probe and continues until the operator throws a switch. Graver Water Conditioning Co., 216 W. 14th St., New York 11.

Piping Connection For Various Pressures

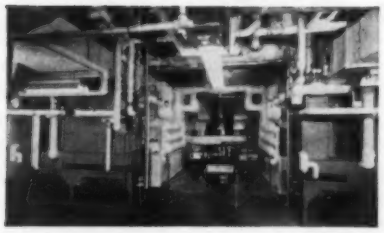
A new connection has been designed which offers a "one specification" connection for all piping applications and pressure ratings, the manufacturer reports. It is said to require no selection of gaskets, facings or bolts, and have all parts interchangeable and reusable. The connection employs a two-belt clamping principle and a stored energy seal. A steel sealing ring, having flexible lips



KATHABAR HUMIDITY CONDITIONING

CUTS BAR-COOLING TIME 98.7%

with continuous frost-free air at 0°F



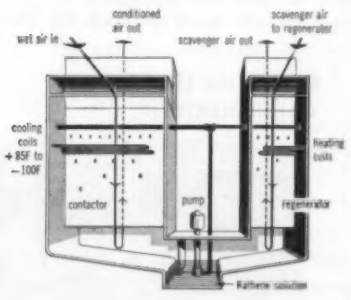
There's no excuse for letting the weather put the brakes on candy production. Here's proof: one of the world's largest candy makers has cut bar-cooling time *from 16 hours to 12 minutes* with a continuous process and sub-freezing, frost-free air, all year 'round. They decided what they wanted the process to do; they achieved it with Kathabar humidity conditioning.

Kathabar units, teamed with refrigeration, supply air at 0°F and 2 grains/lb. to 8 cooling tunnels. With the Kathabar system to remove moisture that causes frost and condensation, refrigeration handles the cooling load with minimum power consumption, maximum efficiency. Duplicate coils, once required to operate during defrosting, are eliminated along with the frost.

The Kathabar units operate continuously and automatically, without dual batteries or storage space for bulky dry desiccants, and without carryover of the chemical absorbent into conditioned spaces.

In addition to cooling, candy manufacturers have profitably applied Kathabar equipment to many other processes, such as drying, polishing, coating, bottoming, packaging, storage, and employee comfort. Whether your operations are batch or continuous, large or small, it will pay you to learn what Kathabar humidity conditioning can do to help you make better candy at any time, at lower cost. Send for Literature Group K-54-7.

WHAT COULD BE SIMPLER?

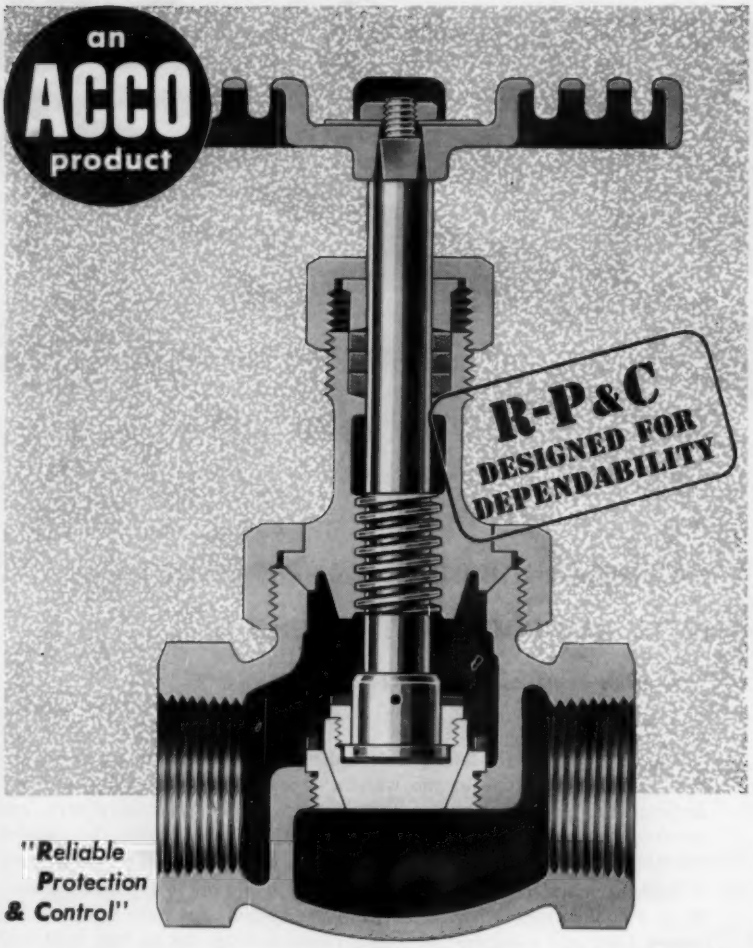


Air to be conditioned passes through the contactor, where an absorbent solution removes moisture (the amount depends on the automatically-controlled temperature of the solution). In the automatic regeneration, about 15% of he soution is heated, and the moisture it releases is blown out the window.

Kathabar®
HUMIDITY CONDITIONING

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

ALSO MAKERS OF *Surface* INDUSTRIAL FURNACES *Janitrol* AUTOMATIC SPACE HEATING



New R-P&C Bronze Globe Valve

—STAINLESS STEEL SEAT AND DISC (500 BRINELL)
—FULL-PLUG FOR CLOSER REGULATION, LONGER LIFE

R-P&C's new **Fig. 427-DP** bronze globe valve is recommended for steam, water, oil and gas service where control or regulation of flow is required. Its 500 Brinell stainless steel seat and disc resist wire-drawing—make it particularly suitable for continuous throttling and other severe applications.

• The Fig. 427-DP is packed with the quality features that users expect from R-P&C. For example, the union bonnet for added strength and convenience, and a disc and seat ring construction which permits regrinding without removing the valve from the line. The full-plug construction, with its exceptional wide seating surface, gives closer control, longer life.

• The Fig. 427-DP is rated for 300 lbs. Steam—1000 lbs. OWG in sizes ¼" to 2", and 600 OWG in sizes 2½" and 3". Also supplied as an angle valve. Precisely designed, it is a fitting addition to R-P&C's complete line of bronze valves—gates, globes, angles and checks, in pressure classes from 125 to 300 lbs. See your R-P&C Distributor or write for catalog.

ACCO

R-P&C Valve Division
AMERICAN CHAIN & CABLE

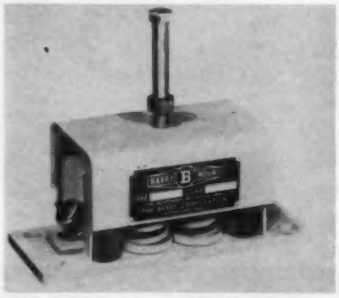
Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

EQUIPMENT DEVELOPMENTS
Continued

and a rigid rib, fits between the steel connecting hubs. The angle of the tapered lips of the ring is less than the tapered seats of the hubs. As the joint is made up, the lips of the seal ring conform to the seats of the hubs, thereby utilizing the elasticity of the steel as a source of stored energy to effect a positive seal, according to the company. Gray Tool Co., Houston.

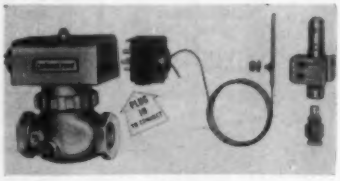
Spring Mount For High Impact Applications



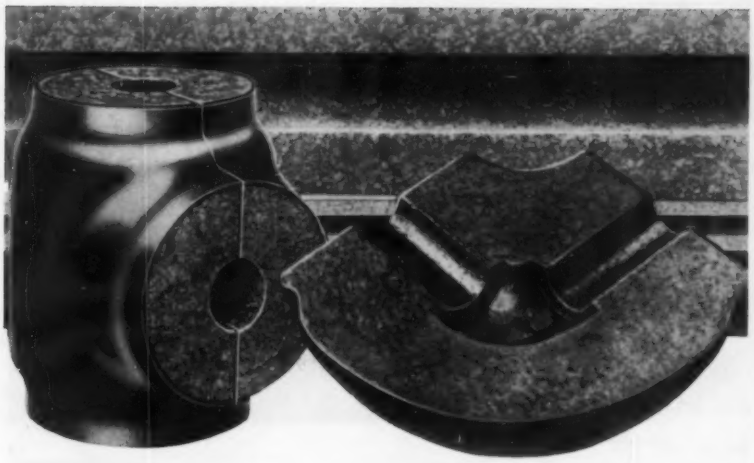
A spring mount for isolating low speeds for high impact applications has leveling features and is designed for use where high absorption of vibration is necessary or where soft floors make control of vibration frequencies difficult, the company states.

Available in five sizes, with 1, 2, 4, 6, or 9 springs, the units, depending on size, have an effective load range from 250 to 6700 lb, says the company. Barry Corp., 765 Pleasant St., Watertown 72, Mass.

Pilot and Gas Valve Combination



A variation of the manufacturer's new solenoid gas valve permits the addition of the pilot merely by plugging it in, the company reports. The pilot combines a snap action switch and a mercury actuated thermal element, according to the manufacturer.



UNITED CORK PIPE COVERING

Light Duty Thickness (Ice Water)	to 30° F
Medium Duty Thickness (Brine and Ammonia)	to 0° F
Heavy Duty Thickness (Heavy Brine)	to —25° F or lower

For all standard pipe sizes and fittings. Molded of compressed pure granulated cork, finished with moisture-proof mineral mastic.

LARGER STOCKS...FASTER DELIVERY...PERSONAL SERVICE

United Cork Companies have expanded their facilities to include the production of cork pipe covering. Increased quantities of most frequently used sizes are now available at key points coast to coast . . . in either distributor or branch warehouse stocks . . . thus insuring fast delivery of your installation requirements.

CORK. . . STILL UNSURPASSED AS A COLD LINE INSULATOR

- Extremely low thermal conductivity
- Saves at least 80% of refrigeration lost from bare piping
- Easily economically applied
- Permanent and durable, lowest long-term cost
- Does not support combustion
- Neat, sanitary, vermin-proof
- Has no capillarity

YOUR INQUIRY will bring you specifications, helpful installation data, descriptive material on United's cork pipe covering . . . and patented BB (block-baked) 100% Corkboard specially processed for low temperature work. No obligation.

UNITED BB CORKBOARD

SEE OUR CATALOG IN SWEET'S

UNITED CORK COMPANIES

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Dept. I-21

Manufacturers of cork insulation for almost a half century

Engineering offices, or approved distributors, in key cities — coast to coast.

TEAR OUT AND MAIL!

YES! I would like to know more about

STAR-KIMBLE

Special Motor Designs

☐ If your sales engineer will give me a ring, I'd like to talk to him AND IN THE MEANTIME, you might send me your bulletin on Standard

☐ **SQUIRREL CAGE**

☐ **WOUND ROTOR**

☐ **D-C MOTORS**

Generators, M-G Sets

*My name is*_____

*They call me a*_____ *(title)*

*At*_____ *(company)*

_____ *(street address)*

_____ *(city) (zone) (state)*

STAR-KIMBLE

MOTOR DIVISION

Miehle Printing Press and Mfg. Co.

219 Bloomfield Ave., Bloomfield, N. J.

COOLING WITH STEAM

C. H. WHEELER STEAM JET EJECTORS

In most cases if a process steam system is large enough for heating in winter, it can be used economically to provide air conditioning in the summer, because the increased steam load costs less per pound than the part load for process alone. A C. H. Wheeler Steam Jet Ejector system becomes most economical when air conditioning requirements exceed 100 tons. By means of this system water is chilled to as low as 50-55°F. with steam pressure of 50 psi or over. C. H. Wheeler has always led in the development of the steam jet ejector and its application to industrial refrigerating requirements. We invite your correspondence.

(Catalog 1462 is available.)

Note: In many areas utilities offer an attractive street steam rate in summer, which makes the steam jet ejector system economical for air conditioning large commercial and public buildings.

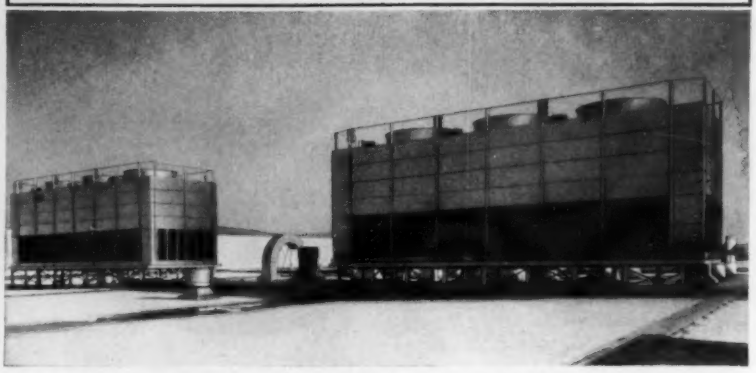
WE-509

C.H. Wheeler of Philadelphia

19TH AND LEHIGH AVE., PHILADELPHIA 32, PA.

BINKS cooling systems

COOLING TOWER NEWS



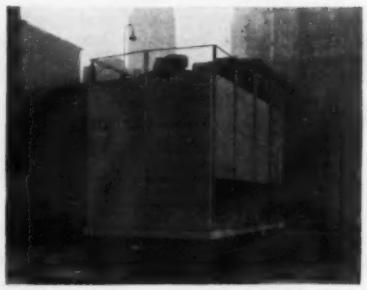
These two Binks Cooling Towers cool water for industrial processing (see text)

Each of these cooling towers solves a specific problem...

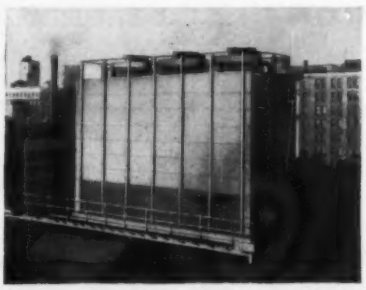
The two towers illustrated above are on the roof of a large industrial plant. The one on the right cools 4000 gals. of quench water per minute. The other cools 2850 gals. of water a minute for electrical heat treating equipment. The air intakes on this tower are equipped with filters to trap all dirt and dust and to keep the cooling water clean.

The towers shown to the right are used in the air conditioning systems of two large commercial buildings. The one tower had no space restrictions, the other was very limited...But Binks Engineers met both conditions with a tower that assures excellent cooling, long trouble-free service and definite economies.

Engineering help available Binks manufactures cooling towers of all types and capacities ranging from small residential-types of 3 gpm to giant towers of 15,000 gpm. To help you get the right tower a Binks Engineer will study your needs and submit proposals without obligation. For full details write to:



This tower serves a large Chicago store using 500 tons of refrigeration



On top of a tall office building using 535 tons of air conditioning

Binks EVERYTHING FOR WATER COOLING

A COMPLETE LINE OF NATURAL DRAFT AND MECHANICAL DRAFT COOLING TOWERS AND INDUSTRIAL SPRAY NOZZLES

BINKS MANUFACTURING COMPANY

3118-38 Carroll Ave., Chicago 12, Ill.

REPRESENTATIVES IN PRINCIPAL U.S. & CANADIAN CITIES • SEE YOUR CLASSIFIED DIRECTORY

EQUIPMENT DEVELOPMENTS

Continued

Units are available in both automatic and manual reset types, and come unassembled in three basic subassemblies; switch and thermal element, pilot burner and bracket, and orifice fitting, says the company. Valves are available in ½, ¾ and 1 in. sizes with capacities of 340, 450 and 775 cfh. White-Rodgers Electric Co., 1209 Cass Ave., St. Louis 6.

Submersible Sump Pumps Without Floats, Rods

A new submersible sump pump, said to be capable of handling up to 3250 gph, has no outside floats or rods. The motor housing is the float and is adjustable to the operating range desired, says the company. The unit is said to operate in water up to 15 ft in depth.

The 1/3 hp motor and switch are enclosed and sealed in a stainless steel housing and no lubrication is required, according to the manufacturer. The discharge is threaded for 1 ¼ in. pipe. Carver Pump Co., 1460 Hershey Ave., Muscatine, Ia.

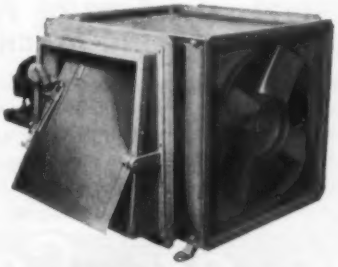
New Indicating Temperature Control

Designed for controlling and indicating temperatures of gases, liquids and hot plates within limits of −150 F and 650 F, the manufacturer's type "E32N" indicating temperature control has the following new features, the company reports:

The calibrating mechanism compensates movement errors of commercial thermal systems, permitting replacement of these systems in the

"...Let's cut this stack off here and put a Wing Draft Inducer on the boiler...We'll save the cost of the chimney, have better draft and a better looking building."

If you are building or rebuilding or increasing the size of your boiler plant, a costly, tall chimney can add considerably to the expense. And a well planned architectural design can be ruined with an unsightly, towering stack.



WING DRAFT INDUCERS eliminate this problem, providing positive, adequate, uniform draft regardless of surrounding conditions, or variable weather. They cut operating costs too, by giving higher CO_2's. Smoking is reduced or eliminated. Higher boiler capacity is possible.

Write for Bulletin I-55

Wing

L. J. Wing Mfg. Co.
140 Vreeland Mills Road
Linden, New Jersey
Factories: Linden, N.J. and Montreal, Can.

EQUIPMENT DEVELOPMENTS

Continued

field without loss of calibration accuracy. A 12 in. revolving scale rotates against a fixed index pointer, allowing readability and cutting down reading errors due to parallax. Each model is automatically compensated for ambient and overtravel temperatures to maintain the control point at its calibration accuracy under conditions met with controls of this type. United Electric Controls Co., 85 School St., Watertown 72, Mass.

All Purpose Thermometer With Added Protection

The manufacturer's "Serviceman" all purpose thermometer has been redesigned to give added protection at the points of greatest wear and also increase the ease of operation, the company reports.

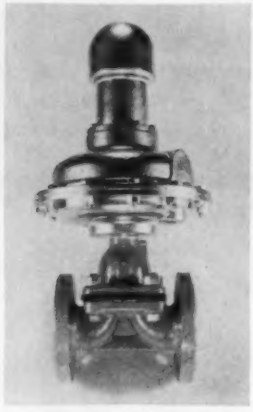
To protect the armored capillary tubing, the edge of the back reel plate has been rounded and a new bulb bushing with a coiled spring capillary protector has been added at the point of the bulb and capillary tube, the manufacturer says. The molded

crystal face has been changed to "Plexiglas," which is said to be stronger than the old plastic face, more resistant to scratches and not harmed by refrigerant gases and oils.

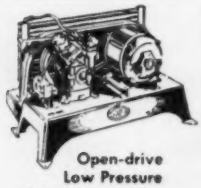
Thermometers are available in two standard ranges, −40 to 65 F and −10 to 100 F. Marsh Instrument Co., 3501 Howard St., Skokie, Ill.

Air Operated Valves Of Various Materials

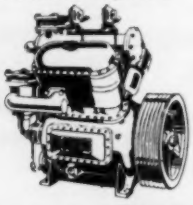
A new line of air operated valves, sizes ½ through 4 in., both flanged and screwed in spring type and springless, is available in cast iron, cast steel, stainless steel, aluminum everdur, hastelloy, and durimet, says the company. They are also available with rubber, neoprene, saran, hard rubber or glass linings, the manufacturer reports.



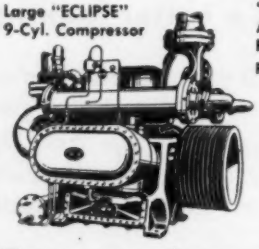
Advantages cited by the company are low maintenance costs, bubble tight on air, low replacement cost, simple body construction, and adaptability for vacuum service. Uniflow Valve Corp., Box 171, Linden, N.J.


Open-drive Low Pressure Units, ¼ to 15 Hp.

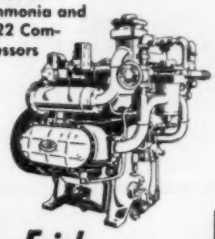
"ECLIPSE" Compressors, 2, 3, 4, 6 or 9 Cylinders

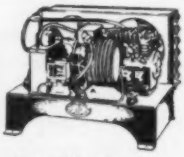


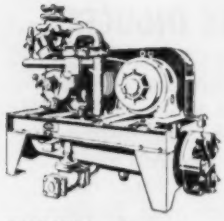
Large "ECLIPSE" 9-Cyl. Compressor



"ECLIPSE" Ammonia and F-22 Compressors

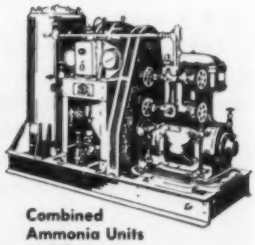



Accessible-Hermetic Units, ¼ thru 7½ Hp.


"ECLIPSE" Low Pressure Units in 5 Sizes

83 TYPES AND SIZES OF *Frick* REFRIGERATING MACHINES

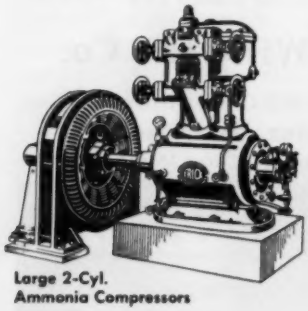
Most comprehensive line of compressors in the Industry. There's one to meet the needs of your business exactly. Handle any commercial or industrial load, at any temperature, with any refrigerant! Get the full facts and figures now: write, wire or phone

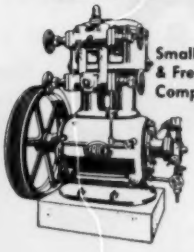

Combined Ammonia Units in 3 Sizes

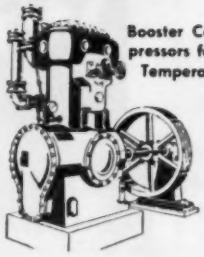
DEPENDABLE REFRIGERATION SINCE 1882

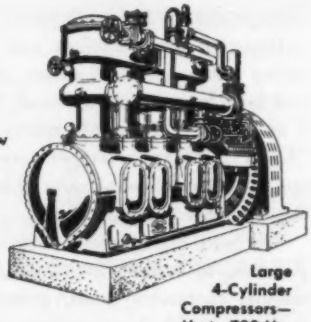
FRICK CO.

WAYNESBORO, PENNA. U.S.A.


Large 2-Cyl. Ammonia Compressors


Small Ammonia & Freon-22 Compressors.

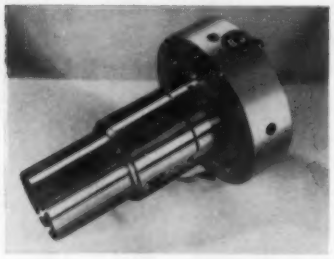

Booster Compressors for Low Temperatures


Large 4-Cylinder Compressors—Up to 700 Hp.

EQUIPMENT DEVELOPMENTS

Continued

Mechanical Seal For Boiler Feed Pumps



A new type "BJ" mechanical seal for high pressure boiler feed pumps is designed to stop liquid loss, reduce heat loss and to require no operating adjustment, according to the company.

These seals are now in operation in a number of high pressure, hot water pumping operations including temperatures up to 430 F, the company says. Byron Jackson Co., Mechanical Seal Section, P.O. Box 2017, Terminal Annex, Los Angeles 54.

Rubber Grommet Pressure Seal For Smooth Tubing

The manufacturer's "Roll-Lock" grommets assembled on smooth tubing will provide hydrostatic pressures up to 225 psi. Higher pressures can be accommodated with only slight changes in grommet shape, the company reports.

In addition to serving in the conventional capacities, the unit seals against entry of water, air, dust, moisture, chemicals and solvents, according to the manufacturer. It is

recommended for such applications as electrical assemblies where protection from hazardous atmospheres is necessary. The Stalwart Rubber Co., 381 Northfield Rd., Bedford, Ohio.

Electromagnetic Control Room Air Conditioners

The manufacturer's 1955 line of "Fresh'nd-Aire" room air conditioners features electromagnetic push-button controls and is available in three separate series, the company announces.

The "Deluxe" series has eight push-button controls and is available in ½, ¾, 1 and 1½ ton capacity models; the "Custom" line, with four controls, has units with ½, ¾ and 1 ton capacities; and the "Standard" series has three controls and comes in ¾, 1 and 1½ ton capacity models, the manufacturer reports. Cory Corp., 221 N. LaSalle St., Chicago 1.

RITE "LIME-LITE" with built-in heat Exchanger, having full boiler output.

The "Rite" Story Behind The "Rite" Trade Mark

The finest, largest, and MOST EFFICIENT Boilers ever built are of WATER TUBE design. The pressure sections are built of STEEL. Because of its superior durability and strength, steel has become the most widely used structural material conceived by man. The fire box sections are built of refractory brick. Essentially, they are a furnace, where efficient combustion can take place, and a bundle of water-filled tubes to extract the heat from the combustion products.

Boilers of this type can be found in practically every large city in the world as a power source for a pumping station or electrical power plant. The amazing thing about this fact is many of them were installed during the late 1800's or shortly after the turn of the century and they are still giving faithful, efficient service. To thousands of architects, engineers, and users the words WATER TUBE, STEEL, EFFICIENCY, PERMANENCE became SYNONYMOUS.

Now, by combining these fine features with Modern Materials, Automatic Controls, and Production Engineering, Rite Engineering and Manufacturing Corporation offers to the heating and air conditioning trade a Completely Automatic Water Tube Boiler at reasonable cost. 33 Different Sizes — Gas, Oil or Gas Combination, Water Heating, Hot Water Supply, Low Pressure Steam. Both Steam and Water Boilers with Built-in Heat Exchanger having Full Boiler Output. We urge you to contact your nearest agent or our factory for further information.

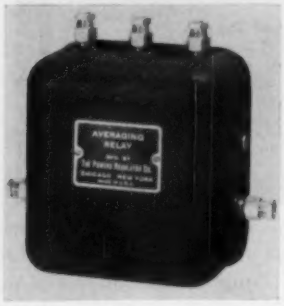
"RITE" LOW PRESSURE STEAM BOILER with modulation valve, electronic pilot safety system, including automatic relighting.

RITE ENGINEERING AND MANUFACTURING CORPORATION
144 South Mission Road Los Angeles 33, California

EQUIPMENT DEVELOPMENTS

Continued

Relays To Control Air Volume, Pressure

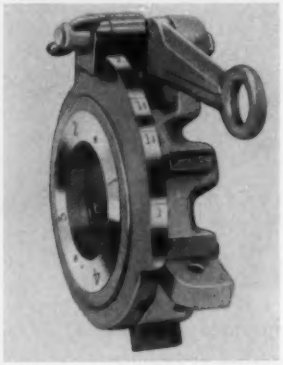


The company's new line of air relays are air volume amplifying; pressure reversing, retarding, advancing and averaging; differential controlling; and minimum pressure controlling; according to the company.

A device allows the highest of two varying air supply pressures to determine the control pressure, says the company. Another is designed to act as a check valve, permitting air flow in one direction only. An electro-pneumatic valve allows air passage only when the solenoid is energized, states the manufacturer. Powers Regulator Co., Skokie, Ill.

Die Head For Pipe Threader

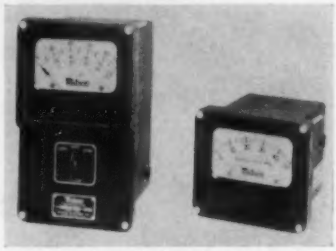
One set of the manufacturer's new "Quadra-Type" die heads, with die segments 1⅛ in. wide standard length thread, will thread all four pipe sizes from 1 to 2 in., the company



states. The head is said to hold thread graduation easily and not to slip. Thread after thread can be cut without resetting, says the manufacturer.

The unit is adjustable to cut standard and over or under standard threads. Beaver Pipe Tools, Inc., 310 Dana Ave., Warren, Ohio.

Redesigned Circuit For Tachometers



A redesigned circuit is now being put on all of the manufacturer's single and triple range tachometers, the company announces. This circuit is engineered to lengthen the life of the units. Single and multiple range indicators can be calibrated in any units of time, says the manufacturer. Metron Instrument Co., 432 Lincoln St., Denver 3.

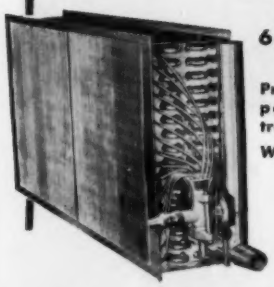
Air Cooling COILS

2 to 15 Ton CAPACITY

NEW Complete Line

REMPE

COMPLETE WITH MULTI-OUTLET EXPANSION VALVES MADE-ON— READY TO INSTALL



4 Row Coils — for residential jobs.

6 Row Coils — for commercial jobs.

Precision built to insure top performance and to give trouble-free service.

Write for bulletins and prices.

Complete facilities for fabrication of pipe coils — all types — all materials. Engineering service. Send details for price.

A request on your letterhead will bring free copy of New Engineering Data Book on Pipe and Fin Coils.

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REMPE COMPANY

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pounds

NOT GUESSES

Install BUILDERS SHUNTFLO STEAM METERS right in your steam lines. Keep track of steam costs by seeing where steam is going and how much. Shuntflo Meters available in Model SMKS (shown) for 2" to 14" lines — Model SMDH for 1" and 1½" lines. Write for Shuntflo Bulletins. Builders-Providence, Inc. (Division of B-I-F Industries, Inc.), 381 Harris Ave., Providence 1, R. I.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC. METERS FEEDERS CONTROLS

...this chemistry laboratory relies on long-lasting

TRANSITE INDUSTRIAL VENT PIPE

Here, in the chemistry laboratory of one of the nation's largest universities, Transite® Industrial Vent Pipe was specified for use in this fume hood installation because of its proven record of performance under severe conditions. It will provide long, trouble-free service without maintenance.

Made of two of nature's most indestructible minerals, asbestos and cement, Transite is highly resistant to the corrosive fumes, vapors and dusts that must so frequently be removed from research laboratories and industrial buildings. Whether installed indoors or outdoors, Transite never requires painting or other preservative coating.

Transite Industrial Vent Pipe offers other advantages, too. It is easy to install because it is light in weight and can be handled readily. No special equipment is needed for cutting on the job. A wide variety of fittings and pipe sizes make it adaptable to every industrial venting service.

For additional information about the use of Transite Industrial Vent Pipe for your venting problems, write to Johns-Manville, Box 60, New York 16, N.Y.

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JOHNS-MANVILLE
TRANSITE INDUSTRIAL VENT PIPE
AN ASBESTOS-CEMENT PRODUCT

Only the d-h *Flexazone* Central-Plant Air Conditioner Gives you

24 ARRANGEMENTS!
ZONES EASILY FIELD ALTERED!
HORIZONTAL OR VERTICAL DISCHARGE!
PLUS
D-H EXCLUSIVE DAMPER ARRANGEMENT
Gives independent, variable control for as many as 7 separate zones

Flexibility—that's the *extra* you get with Flexazone! Only Flexazone can be assembled 24 different ways, depending upon available space—*in the field*. Only Flexazone allows you to add or change zones at any time—*in the field*. And only Flexazone gives you a choice of horizontal or angular air flow from the plenum. These *exclusive* features pay off in cheaper installation, greater design-freedom and lower costs—important benefits, whether you're a contractor, architect, engineer, or building owner!

Want to learn more about Flexazone? Write for bulletin C-4.22.

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EQUIPMENT DEVELOPMENTS

Continued

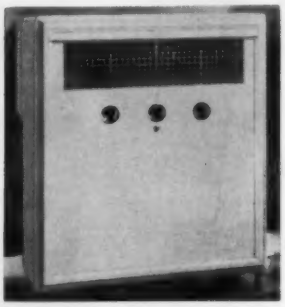
Flame-Resistant Tape For Joining and Sealing

"Scotch" brand No. 474 is a new flame-resistant plastic tape for joining cold and warm air ducts and sealing the joints in industrial heating and air conditioning installations, its manufacturer reports. One wrap of the tape is all that is needed for each sealing application, the company says.

Other advantages cited are longer life, more conformability and greater resistance to humidity changes and moisture vapor. The tape is available in 36 yd rolls in widths from ¼ to 24 in. Minnesota Mining & Mfg. Co., 800 Fauquier St., St. Paul 6.

Adjustable Mount For Air Conditioner

The "Consolaire" air conditioner features the manufacturer's "Adjust-O-Mount" and can be mounted flush with the building line or window



line, the company says. It can be mounted up or down, in or out for the installation's need, states the manufacturer. Remington Air Conditioning Div., Remington Corp., Auburn, N.Y.

New Thermometer With Anti-Parallax Dial

Readings of process changes can now be obtained in the field with the same ease as pressure readings with a new stainless steel "Bi-Metal" dial thermometer, the manufacturer reports.

These thermometers are constructed with an anti-parallax "Maxivision" dial, says the company. Graduations are carried on a raised ring, set close to the cover glass, with the index type hand at the same level. Ranges are available from −80 to 1000 F, according to the company. Manning, Maxwell & Moore, Inc., 250 E. Main St., Stratford, Conn.

Where the problem is ventilation — the solution is a **WESTERN SYSTEM**

AT NORTHROP AIRCRAFT INC.

Problem: The Anaheim, Calif. Division of Northrop Aircraft, Inc. manufactures optical range finders and other ground weapon fire control devices for U.S. Army Ordnance. Dust-free ventilation a must! Solution: 38-30" Western Rotaries with Western-aire Curb-Mounted fans exhaust 18 million cubic feet of air per hour from the 250,000 sq. ft. building.

AT YOUR PLANT

Western Rotary ventilators, with or without fans, can do the most for you. A 2 mph wind operates the Western Rotary—and it continues to exhaust during wind lulls due to superior balance design. Years of trouble-free performance—bearings carry lifetime guarantee. Check Sweet's or AEC for high exhaust capacity figures. Then specify Western—a first-rate line of rotary, stationary, continuous ridge, directional ventilators and exhaust fans. Handled by wholesalers coast to coast.

Western Engineering & Mfg. Co.

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Dealers—order from your local jobber.
Write for catalog, or tell us your special installation problems.

Better Yet,

USE FAIRMONT aluminum

In better parts and accessories for heating and cooling applications, Fairmont 1100 and 3003 wrought aluminum sheet is nationally recognized for highest quality and uniformity. Improved appearance, higher thermal conductivity, light weight, wear-resistant ductility, and non-corrosive and stain-proof surfaces—all these objectives and more are readily achieved.

Fairmont bright aluminum rolling mill products —sheet, coil and circles, are now available for prompt delivery to meet manufacturing schedules.

FALCO

FAIRMONT ALUMINUM COMPANY

Fairmont, West Virginia

How miller welders helped seal the arteries of America's largest single purpose power plant...

Substantial monument to Free Enterprise is OVEC and IKEC, suppliers of electric power to the Atomic Energy Commission's new uranium diffusion center in Pike County, Ohio.

Ohio Valley Electric Corporation and its subsidiary, Indiana-Kentucky Electric Corporation, agreed to supply electric power to this great new atomic production center . . . *15 billion kilowatt-hours annually.*

Two huge generating stations are being built: The Kyger Creek Plant at Cheshire, Ohio will have five generating units of 200,000 KW each; Madison, Indiana's Clifty Creek plant will produce 1,200,000 KW with its six big generators. Each of the eleven turbo-generating units will operate off a single boiler, with super-heated steam reaching 1,050 degrees Fahrenheit under 2,000 lbs. pressure per square inch! The high temperatures and reheat, which the sponsor companies have pioneered in their own right, will make these two plants among the most economical, most efficient generating stations in the country.

Miller Selenium Rectifier d-c Arc Welder, in four wide-range models. For complete, concise, worthwhile information on these and other Miller Arc and Spot Welders, contact us today . . . at no obligation, of course.

These same elements, however, make the fabrication of faultless high-pressure steam lines vital . . . and extremely difficult. To accomplish this extremely important task, pipe welding specialists equipped with the maximum of engineering skill utilized the Miller Selenium Rectifier d-c Arc Welder.

". . . . if it's Miller, you *know* it's the *finest!*"

miller

ELECTRIC MANUFACTURING COMPANY, INC.

APPLETON, WISCONSIN

EQUIPMENT DEVELOPMENTS

Continued

Air Conditioner For Year 'Round Service

"Dual Conditioners," designed to be a new type of year 'round air conditioning system for multiroom installations in institutions, hotels, motels, office buildings and stores, use the same piping circuit now used for heating to cool in summer, heat in winter. The units ventilate in off seasons, reports the manufacturer.

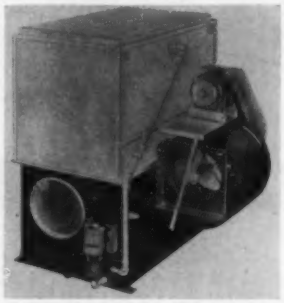
Each room or area is supplied with individual thermostat and capacity control to select desired temperatures, the company says. In conjunction with the existing hot water boiler, a water chiller is supplied to complete the system. Circle Air Industries, 244 Herkimer St., Brooklyn 16.

Power Driven Concrete Saw

A new concrete saw, the model "E-25-PD," is equipped with a 25 hp, 4 cylinder, air cooled, gasoline engine that drives the saw under full load at speeds to 12 fpm, the manufacturer announces.

"Powr-Drive," as the self propelling unit is called, is engaged or disengaged by foot pedals. Cutting speed is set by turning the control lever on the variable speed transmission. Eveready Briksaw Co., 1509 S. Michigan Blvd., Chicago 5.

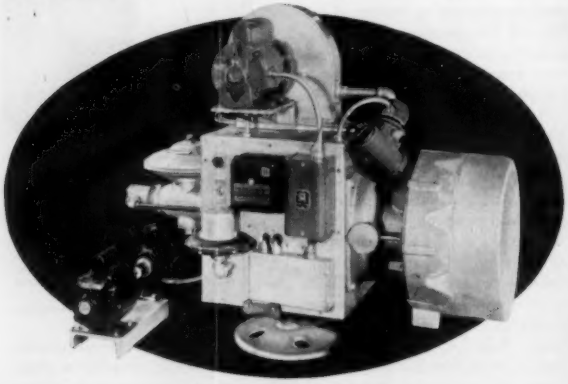
Evaporative Condensers, Cooling Towers



A new line of "Mighty-Mite" evaporative condensers and cooling towers are manufactured with capacities of 10 to 50 tons, "F-12" base rating in 5 ton increments, according to the company.

All moving parts are exposed or within reach to facilitate servicing, says the manufacturer. Steps provide access to the top for removal of eliminators and servicing of sprays, coils and/or surface. Baltimore Air-

NEW completely automatic gas-oil burner



In seven sizes . . .

for firing rates up to 3,000,000 BTU

No fear of being "half-safe"! The new Eclipse SP Combination Gas-Oil Burner has UL approval, is rated "okay" by city boards in Omaha, New York, Minneapolis, Cleveland, Dayton, St. Louis. *No extras to buy and install!* Burner comes ready to fire. You just connect the power source, limit controls, and gas-oil lines. True rotary combustion assures maximum heating efficiency. *No need to delay!* Start saving time and money by converting obsolete burner equipment to automatic dual-fuel firing. Write for bulletin R-100.

ECLIPSE FUEL ENGINEERING CO., 1139 Buchanan Street, Rockford, Illinois
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Eclipse BURNERS

HEAT when and where you need it — at the flip of a switch.

SAVE on low initial cost, simple installation and efficient operation.

ENJOY fully automatic controls and years of dependable performance.

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Direct Fired Unit Heaters for gas, oil, coal or dual gas and oil. Capacities from 300,000 to 7,500,000 B.T.U. per hour.

Arthur A. Olson & Company
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there is a difference

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● Universal Vitrified Tile Conduits are permanent — will not disintegrate — need no additional protection against deterioration.

Universal Sewer Pipe Corporation has been manufacturing conduits for 45 years.

Installations are simple and economical.

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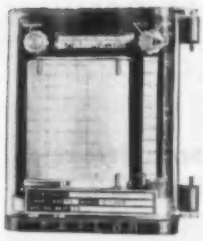
Steam Conduit Division
1500 UNION COMMERCE BLDG. • CLEVELAND 14, OHIO



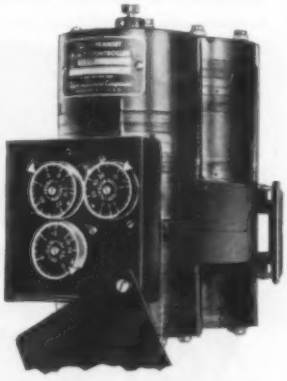
ON THE RECORD-

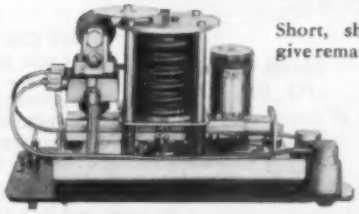
THE Taylor TRANSET* Recording Receiver gives you 30 days on the record — three hours of it visible — and yet it fits a 3⅞" x 4½" panel opening. This midget recorder is designed to work with the TRANSAIRE* Transmitters and TRI-ACT* Controller to give better measurement, control and recording of air temperatures. Other features are: automatic to manual control; remote set-point indicator; chart reading from left to right, on rectilinear coordinates, as an engineer would normally plot variables for study.

The Taylor TRANSET System will give you more accurate measurement, closer control and continuous space-saving records. Ask your Taylor Field Engineer for full details, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Taylor TRI-ACT Controller

Combines all 3 response adjustments—gain, reset rate and PRE-ACT* responses. Provides faster recovery on load changes; start-up with no overpeaking; benefits of automatic reset without its evils. Easy to align. Settings "stay put".





Taylor TRANSAIRE Temperature Transmitter

Short, shiftable range spans give remarkable accuracy—½% of range span on critical applications. Force-balance action. It transmits temperatures asfaras 1,000 ft. from point of measurement.

*Trade Mark

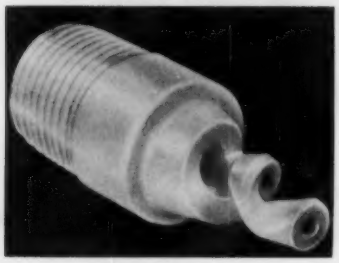
Taylor Instruments
MEAN ACCURACY FIRST

EQUIPMENT DEVELOPMENTS

Continued

coil Co., Inc., 2615-35 Mathews St., Baltimore 18.

One Piece Spray Nozzles Of Spiral Design

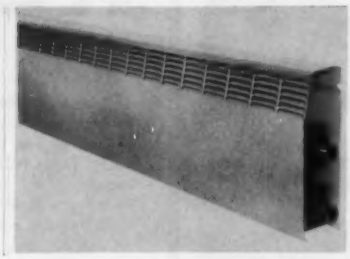


A new line of "Teflon" spray nozzles is designed to be nonclogging, corrosion-resistant with most sprays, and long wearing, its manufacturer reports. Due to a spiral design each nozzle can be made from one small piece of "Teflon," says the company.

The nozzles, called the "TF" series, are available in ten models with narrow angle (50 deg) or wide angle (120 deg) hollow cone spray patterns in five different flow rates from 5 to 50 gpm. They are threaded with ⅜ or ½ in. male pipe threads. Bete Fog Nozzle, Inc., 309 Wells St., Greenfield, Mass.

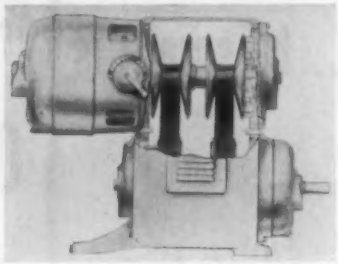
Wall Mounted Radiation In 1-3 Tier Assemblies

A new line of along-the-wall radiation, called "Thermo Vector," comes in one, two, or three tier assemblies the manufacturer announces. It is flush mounted anywhere along a wall at a minimum of 4 in. above the floor and can be used with steam or hot water, the company says.



The enclosure, made of heavy furniture steel, has a front outlet grille designed to direct the warmed air from walls to prevent smudging. C. A. Dunham Co., 400 W. Madison St., Chicago.

Increased Rating For Variable Speed Motor



Designed to provide for extra heavy duty services where variable speeds are needed, the manufacturer's "Varidrive" motor has been upped from 50 to 60 hp, the company says.

These large capacity motors may be equipped with remote controls, either mechanical or electrical, says the manufacturer. Motors are equipped with dual belts of double ribbed design, which are said to divide the transmission load. U.S. Electrical Motors, Inc., Box 2058, Los Angeles 54.

AIR HANDLING UNITS
24 DIFFERENT SIZES FOR PIN-POINT SELECTION
FROM 2 TONS TO 60 TONS
400 CFM TO 26,000 CFM IN BOTH VERTICAL AND HORIZONTAL CABINETS

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Choose exactly what you want with Governair Air Handling Units. Secure more closely controlled balance of system load by simple selection of air handling component. 24 complete and individual sizes for greater flexibility.

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- **Spray and pan type humidifiers**

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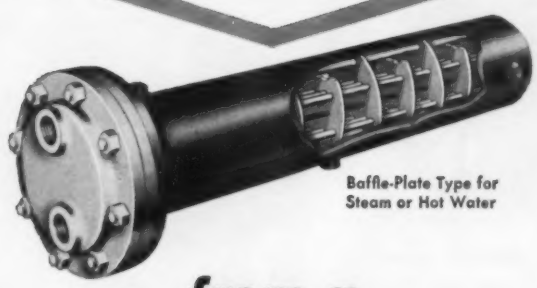
Fuel Oil Heaters

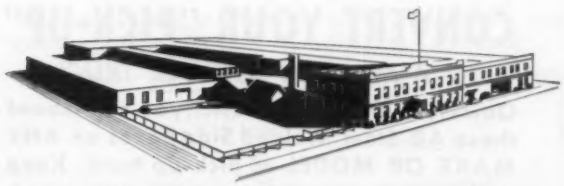


Baffle-Plate Type for Steam or Hot Water

from a *Reliable* Source

Finest quality materials and construction . . . top engineering skill . . . more than 25 years of manufacturing experience! These are only a few of the reasons behind General Fittings Company's reputation for dependable service. And they're excellent reasons why you can depend on GENERAL Fuel Oil Heaters.

The GENERAL BO Fuel Oil Heater features baffle-plate construction for high heat transfer efficiency . . . low pressure drop. Made with welded steel shell, cast steel head. Gasket surfaces are machined . . . tubing *electronically* expanded into tube sheets. Every unit is tested 500# air-underwater. The result is a rugged "package" designed for lasting performance . . . unsurpassed in its class. Complete line of other fuel oil heater designs also available. Write for new Catalog No. 62. General Fittings Company, Dept. A, 123 Georgia Avenue, Providence 5, Rhode Island.

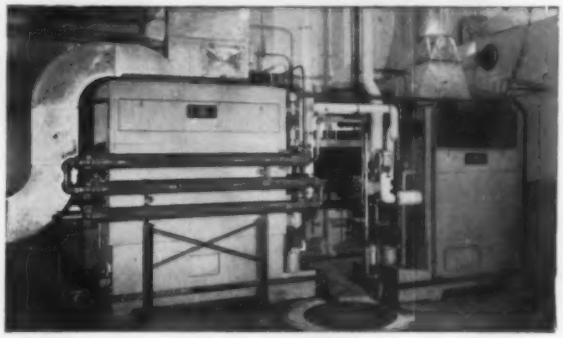


GENERAL FITTINGS COMPANY

TANKLESS AND INDIRECT WATER HEATERS AND HEATING SPECIALTIES

This NEW METHOD DRIES AIR

PRECISELY AS YOU WANT IT



NIAGARA CONTROLLED HUMIDITY AIR CONDITIONING

This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is

Best and most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always. Niagara machines using liquid contact means of drying air have given over 20 years of service.

Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Easiest to take care of because . . . the apparatus is simple, parts are accessible, controls are trustworthy.

Most compact, taking less space for installation.

Inexpensive to operate because . . . no re-heat is needed to obtain the relative humidity you wish in normal temperature ranges and frequently no refrigeration is used to remove moisture.

The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

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Sales Engineers in Principal Cities of U. S. and Canada

EQUIPMENT DEVELOPMENTS
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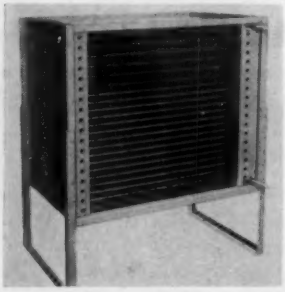
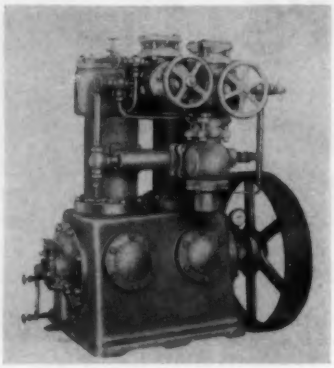
Air Cooled Condenser For Cooling Systems



"Atmos-Therm," a new air cooled condenser, is designed to derive the maximum cooling effect from air and eliminate the need for water in air conditioning systems, according to its manufacturer. The unit is said to change the hot gas to a liquid ready for use at the expansion valve.

The condenser is a fin coil with copper tubes and aluminum fins with a weatherproof casing of heavy gage steel. Construction is designed to eliminate vibration and promote quiet operation, the company says. The unit is available in four models; 2, 3, 5 and 7 ½ ton. Rempe Co., 340 N. Sacramento Blvd., Chicago 12.

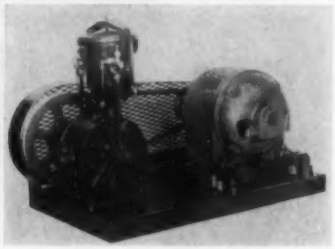
Ammonia Booster Compressors



A new line of ammonia booster compressors in both two and three cylinder models is available with capacities ranging from 5 to 75 tons, the manufacturer announces.

Features cited by the company are heavy duty construction, elimination of oil pumping and heating and valve breakage problems, crankshaft seal with lubricating oil under pressure, positive seal prevents air infiltration under vacuum conditions, and internal force feed lubrication to all bearings. Compressor parts are interchangeable with the company's standard units, and no automatic oil return is required. Howe Ice Machine Co., 2825 W. Montrose Ave., Chicago 18.

Compact Design Of Air Pumps



The use of smaller, more compact motors and belt drive mechanisms in the manufacturer's line of base mounted electric motor driven air pump units has resulted in considerable reduction in base size on all models, according to the company.

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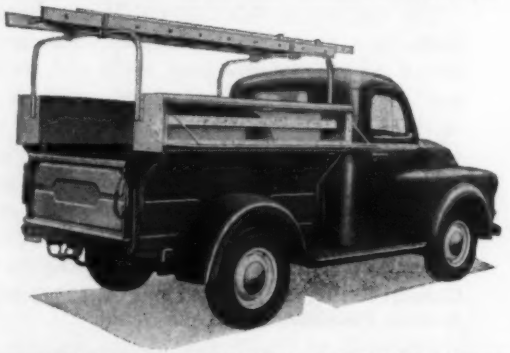

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For combustion testing in the field!

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The first of its type developed for field work, the Hays Analyzer answers the need for an Orsat type gas analyzer husky enough for use in the boiler room and for installation and service work in commercial and home heating plants, yet simple, fast and accurate!

It's Rugged—Made with strong pressed steel, the Hays Orsat is designed for continuous boiler room operation and field work . . . takes wear and tear in stride!

It's Portable—The Hays Orsat contains everything needed for *complete* analysis (CO_2, O_2, CO) in one light (only 8 lbs.), easy-to-carry case . . . goes wherever it's needed. Compact, with all parts easily accessible.

Available in one, two or three unit styles. Does a complete testing job for CO_2, O_2 and CO in 3 minutes!

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Automatic Combustion Control
Boiler Panels • CO_2 Recorders
Variflow Meters and Varitrol
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Combustion Test Sets
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
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Michigan City 14, Indiana

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Tuthill Type SU multiple V-belt pumping units provide structural and performance advantages for dependable, uninterrupted operation that add up to reduced maintenance expense.

Features like these make the SU outstanding for handling heavy fuel oils in industrial heating:

- ★ **Motors up to 5 h.p. mounted on slotted slide rails for easy adjustment or replacement. No drilling or tapping required.**
- ★ **Cast iron base with mounting bolts and adjustments easily accessible.**
- ★ **One-point belt-tension adjustment.**
- ★ **Jack shaft, supported by ball-bearing pillow blocks, carries entire weight of pulley and absorbs belt tension.**
- ★ **Pump, jack shaft and pillow blocks available as separate unit.**
- ★ **Pump and jack shaft direct-connected by flexible coupling for better alignment and simplified mounting.**
- ★ **Wide range of pump models and capacities.**

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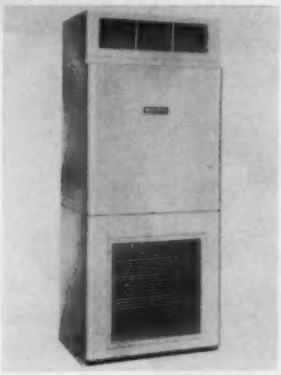
EQUIPMENT DEVELOPMENTS
Continued

Leiman Bros., Inc., 102 Christie St., Newark 5.

Waterless Console Air Conditioner



The manufacturer's new "AIRefrigeration" unit is engineered to provide space or duct type cooling, dehumidifying and air filtering for offices, stores and restaurants, or to supplement present warm air furnace installations, the company reports.

The unit is designed for operation without the use of water, water and sewer connections, water pumps and water towers. It is sectionally engineered for ease of handling and installation, says the manufacturer. Williamson Heater Co., 3500 Madison Rd., Cincinnati 9.

Equipment Briefs . . .

THERMOSTATS designed for use with the manufacturer's "Ribbon Heat" and similar heating tapes in preventing freezing of water pipes, keeping viscous fluids free flowing and similar industrial applications, are available in heavy and light duty models, the company reports. Cox & Co., Inc., New York.

TWO-WIRE THERMOCOUPLE, encased in stainless steel tubing, is available with either of two types of terminal heads; an open head assembly or a screw cover head, the manufacturer announces. Lengths range from 6 to 60 in. Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia 44.

STAPLER, for fastening copper tube lines for radiant heating, may be operated with one hand, leaving the other free to hold the material, according to its manufacturer. The unit loads heavy wire staples in leg lengths up to ¾ in. long, says the company. The Heller Co., 2153 N. Superior Ave., Cleveland 14.

HEADSHIELDS FOR WELDING, made of glass fiber reinforced plastic, are available in two models; one has the lens holder molded into the shield, the other has a lift front lens, the manufacturer reports. Hobart Bros. Co., Troy, Ohio.

CERAMIC BASE MATERIAL for protecting and restoring water tanks is part of a lining system developed by the manufacturer. "Expansolin," is said to expand and contract with the material to which it is bonded. Emjay Maintenance Engineers, 327 Union, Rutherford, N.J.

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Stainless Pipe, Tubing, Welding Fittings

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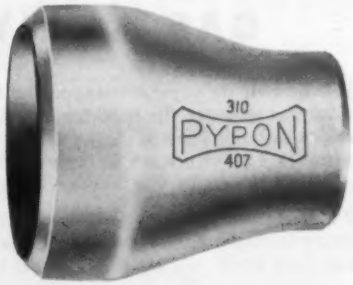

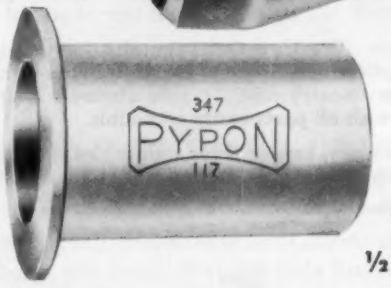

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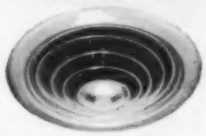

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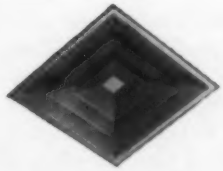

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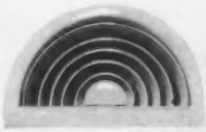
TYPE H—Fully adjustable square diffusers and fixed rectangular 2, 3, and 4 way diffusers.

FOR SIDEWALL & CEILING

TYPE S—With Type R or V blades to supply desired air pattern for ceiling or wall installation.



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For commercial & industrial heating with

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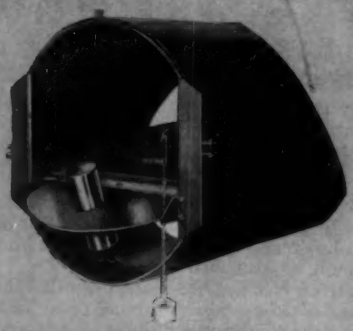

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Now you can eliminate heavy fuel wastes with complete safety. With four years of perfect performance behind it the Field "MG" now carries the recommendation of leading gas companies across the country—fully safe, absolutely dependable, highly efficient. But be sure the control you install is a Field. In a gas installation only a perfect control is a good control.

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AFFILIATES: Conco Building Products, Inc. — Brick, Tile, Stone
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RECENT TRADE LITERATURE...

▸ *AIR CONDITIONERS*—An 8 page bulletin contains information on the manufacturer's new "Multi-Zone" air conditioning units. Marlo Coil Co., 6135 Manchester Ave., St. Louis 10.

▸ *AIR DIFFUSERS*—Bulletins K33 and KH-76A contain information on the manufacturer's lines of high pressure air diffusers and ceiling air diffusers for overhead warm air heating, respectively. Connor Engineering Corp., Danbury, Conn.

▸ *AIR DISTRIBUTION SYSTEMS*—Bulletin 110 is an engineering treatise incorporating the results of laboratory research and experience gained from the design and installation of medium and high pressure air distribution systems now in operation. Tuttle & Bailey, Inc., New Britain, Conn.

▸ *AIR FILTER*—Literature on the manufacturer's new filter designed for high efficiency air filtering in commercial and industrial ventilating and air conditioning systems is available from the company. Cambridge Filter Corp., 738 Erie Blvd., E., Syracuse.

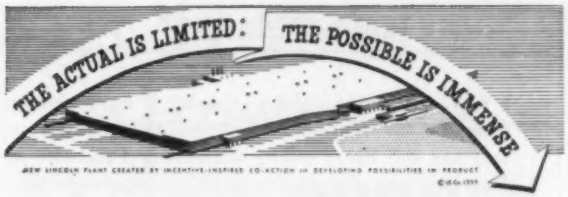
▸ *AIR FILTERS*—A new 10 page booklet on mechanical air filters includes history, principle of operation, application, filter test methods, engineering data, description and suggested specifications. Trion, Inc., 1000 Island Ave., McKees Rocks, Pa.

▸ *AUTOMATIC CONTROLS*—A new 32 page catalog describes the company's line of automatic controls for heating, refrigeration and air conditioning. White-Rodgers Electric Co., St. Louis 6.

▸ *BOILERS*—A new 8 page brochure gives data and specifications on each of the company's "S" series boilers designed for capacities ranging from 10,800 to 50,000 lb of steam per hour. Wm. Bros Boiler & Mfg. Co., 1057 10th Ave., S. E., Minneapolis 14.

▸ *BOILERS*—A new 4 page brochure (AD-137) covering the "LR" and the new "CB" models of self contained boilers has been announced by the manufacturer. Cleaver-Brooks Co., 326 E. Keefe Ave., Milwaukee 12.

▸ *BOILER REFRACTORIES*—A 20 page bulletin, designed to provide operators of stationary and marine boilers with a guide for selecting refractories for their boilers, has recently been prepared by the Refractories Div., The Babcock & Wilcox Co., 161 E. 42nd St., New York 17.



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NOW **rectifier welder with both current and voltage controls**

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NOW **DC welder for operation on single phase power**

Imagine with one welder you now can:

Weld extremely light gauge material with low currents.

Weld heavy metal . . . mild steel and alloys with high currents.

Switch from DC to AC when arc blow limits welding operations.

Handle both production work and maintenance of dies and fixtures . . . at new low cost.

Operate *all* electrodes with top speed . . . top efficiency.

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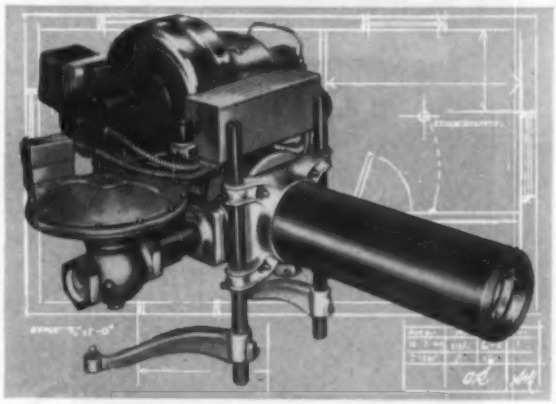
The World's Largest Manufacturer of Arc Welding Equipment

NOW you can specify GAS burners



for your space heating and processing requirements.

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DUAL-FUEL

gas/oil burners

Burn either gas or oil with completely automatic fuel-air changeover at maximum efficiency. Satisfy utility requirements as to gas availability. Operating by outside thermostatic control or remote manual operation. Syncro-flame dual-fuel burners answer your space heating requirements with models ranging in size from 100,000 to 3,000,000 BTU's p/hr on gas—1 to 22 gals. p/hr on oil. 2 to 60 boiler HP.

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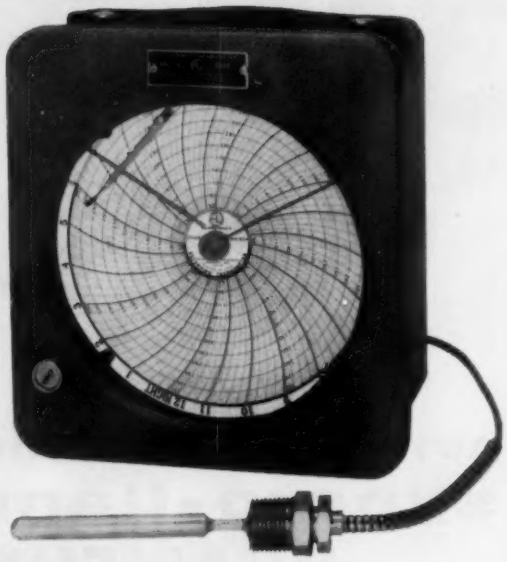

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RECENT TRADE LITERATURE *Continued*

▸ *CEILING DIFFUSERS*—Catalog F 6597 gives information on the company's "Uni-Flo" square, rectangular and linear ceiling diffusers and includes performance data designed to permit engineers to determine job requirements in the layout stage. Barber-Colman Co., Rockford, Ill.

▸ *CELLULAR GLASS INSULATION*—A new brochure shows application of "Foamglas" cellular glass insulation to insulate roofs, ceilings, walls and floors of buildings, cold storage spaces, piping, tanks and equipment. Pittsburgh Corning Corp., 1 Gateway Center, Pittsburgh 22.

▸ *CENTRIFUGAL PUMPS*—Bulletin 1010 presents data on the company's line of centrifugal pumps without seal or stuffing box. In 16 pages, it gives information on sizes, horsepowers, heads and capacities, dimensions, materials of construction, design data and construction features. Chempump Corp., 1300 E. Mermaid Lane, Philadelphia 18.

▸ *COMBUSTION CONTROLS*—Bulletin MSA-116 discusses the manufacturer's line of automatic combustion control systems for use with various types of gas fired boilers. Hagan Corp., 323 4th Ave., Pittsburgh.

▸ *COOLING TOWER PUMPS*—A new manual for sizing cooling tower pumps and piping contains 8 pages showing a six step procedure for selection. Bell & Gossett Co., Morton Grove, Ill.

▸ *ELECTRIC CHECK VALVES*—Covering pertinent data including dimensions, cross sectional views with parts list, suggested wiring diagrams and specifications, a new 8 page technical bulletin is available from Golden-Anderson Specialty Co., 1210 Ridge Ave., Pittsburgh 33.

▸ *EQUIPMENT LIFT*—The manufacturer's "Hoist-It" 2 man equipment lift for erecting air conditioners, compressors, condensers, unit heaters and heavy radiation is covered in form HST-89. Hastings Air Control, Inc., 3215 Leavenworth St., Omaha 5.

▸ *EXPANSION SHELLS, ELECTRIC HAMMERS*—The company's lines of self drilling expansion shells and electric hammers and their accessory equipment are covered in new literature. J. D. Polis Mfg. Co., 2900-20 W. 26th St., Chicago 23.

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A **COMBINATION**

GAS OIL BURNER

WITH

AUTOMATIC CHANGE-OVER

Completely Automatic Change-over GAS to OIL and OIL to GAS

Roberts-Gordon has done it again !

A completely automatic combination gas-oil burner — in three sizes ! Oil capacity . . . 2½ gal. to 30 gal. . . . and available with modulating gas input . . . and 2-stage oil input.

It's compact — completely assembled and factory wired . . . and furnished with plug-in electronic controls for simple servicing !

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Write or phone for literature and details . . .

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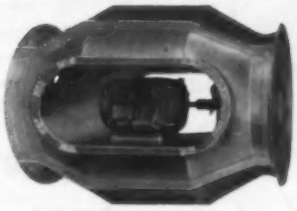

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Glass wool insulated with a protective outer casing for temperatures to 650° F.

Water jacketed with only a trickle of water necessary, for temperatures over 650° F.

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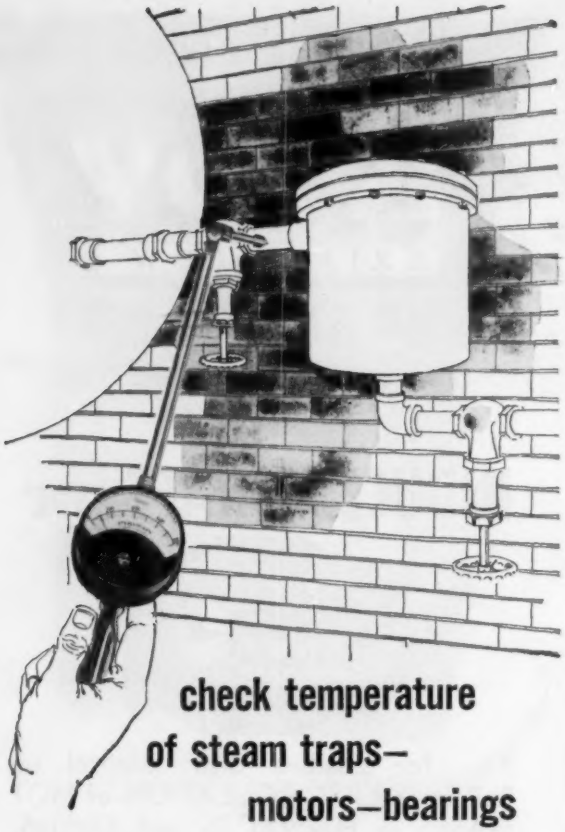

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RECENT TRADE LITERATURE Continued

▸ *HEATING AND HANDLING FUEL OILS*—How to heat and handle heavy fuel oils for use in the burners of boilers, furnaces and processing equipment of industrial and commercial plants and buildings is discussed in the manufacturer's new 8 page bulletin. Preferred Utilities Mfg. Corp., 1860 Broadway, New York 23.

▸ *INDICATING TEMPERATURE CONTROL*—Bulletin 42, a 6 page brochure, describes and illustrates a newly developed instrument designed to control and indicate temperature of gases, liquids or hot plates over wide ranges. United Electric Controls Co., 85 School St., Watertown, Mass.

▸ *INDICATING TEMPERATURE CONTROLLER*—Performance specifications, application ideas and a description of a new liquid filled, remote indicating temperature controller are presented in a 2 color brochure. Fenwal, Inc., Ashland, Mass.

▸ *INDUCED DRAFT FANS*—Literature from the manufacturer gives complete data, specifications, diagrams, prices, etc., on a line of induced draft fans. Whitty Co., Inc., 86 Western Ave., Boston 34.

▸ *INDUSTRIAL HOSE*—Four new industrial hose catalogs in color, covering the company's line of welding, steam, air and petroleum hose, are designed to aid in the selection of hose best suited for the particular application. Boston Woven Hose & Rubber Co., P.O. Box 1071, Boston 3.

▸ *INDUSTRIAL HOSE AND FITTINGS*—The manufacturer's *Yellow Book*, a 132 page industrial products catalog, gives information on industrial hose and fittings for designers of hydraulic and pneumatic control systems. The Weatherhead Co., 300 E. 131st St., Cleveland 8.

▸ *INSULATED PIPING SYSTEMS*—A new 90 page catalog illustrates and gives specifications of the company's insulated piping systems for underground or overhead use. The catalog is divided into five sections; product, engineering, specifications, drawings and installation. Ric-wiL, Inc., Barberton, Ohio.

▸ *INSULATION*—The manufacturer's 8 page *Buying and Selling Guide* illustrates and gives specifications and prices for pipe and duct insulation and asbestos products. Grant Wilson, Inc., 141 W. Jackson Blvd., Chicago.

▸ *LIQUID CHILLER*—The manufacturer's "Flow-Therm" liquid chiller for air conditioning, heat pump

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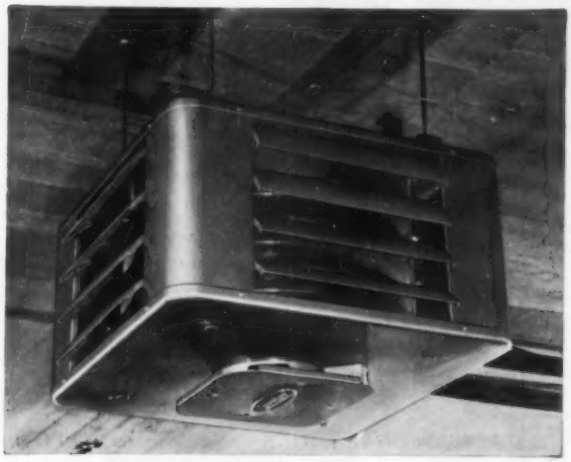
Carrier has fifty years of experience in "making" and controlling temperatures. Today Carrier offers a choice of steam and hot water unit heaters in various types and a wide range of sizes. All are of highly advanced design for the efficient distribution of heat in factories, warehouses, display rooms and the like.



The Carrier 4-way Directed-flo Unit Heater

is the answer to the problem of heating large spaces. In contrast to conventional types of unit heaters, the directional-flo unit will heat three times the same area more economically and at a lower initial cost. Fewer heating elements are required. Less piping, valves and fittings are needed. The 4-way delivers quick heat downward from any or all four sides . . . as much or as little as wanted. Eight sizes—82,000 to 590,000 Btu/hr.

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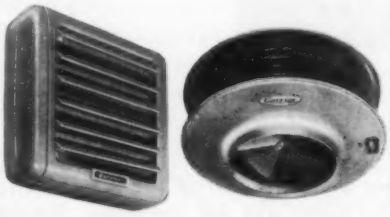
CARRIER Horizontal Air Discharge Unit Heater is powerful, smartly styled and quiet in operation. For retail shops, restaurants, garages, offices. Sizes 21,000 to 200,000 Btu/hr.

CARRIER Projection Type Unit Heater gives very efficient down-blow heat distribution, even from high ceiling installation. Choice of standard or low temperature rise coils. 30,000 to 576,000 Btu/hr.



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Send folders on features and selection data of Carrier Steam and Hot Water Unit Heaters.

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IT'S Waterloo AIR DIFFUSION EQUIPMENT SINCE 1902

IN AIR DIFFUSION EQUIPMENT! *Join the Distinguished Group*

OF ARCHITECTS — ENGINEERS — CONTRACTORS who specify WATERLOO Grilles and Registers to be sure of equipment that is *tops* in performance and appearance, *low* in decibel rating. Waterloo Equipment is now successfully meeting air diffusion requirements in many of the Nation's finest schools, churches, hospitals, medical centers, government, industrial and office buildings, hotels, apartments, stores, theatres and restaurants.

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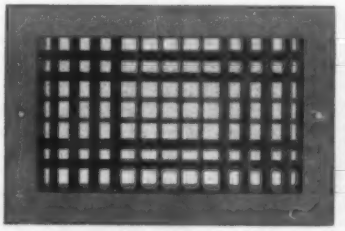

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For long or short throw. Each blade individually adjustable for 4-way deflection at degree desired.

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Storage Tanks for other Industrial Liquids—gasoline, solvents, acids, etc.

HERE'S WHY:

Can be installed on tanks above or below the ground and up to ¼ of a mile away.

No troublesome moving parts—operates on the principle of the U-tube. Simple, dependable and accurate.

Large, easy-to-read vertical scale gives tank contents at a glance. Scales are easily changed for different liquids.

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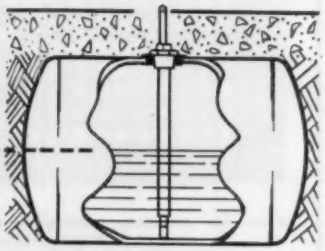

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RECENT TRADE LITERATURE

Continued

and industrial liquid cooling applications is described in catalog No. 220-A. Acme Industries, Inc., Jackson, Mich.

▸ *LIQUID EYE INDICATORS*—The new D-55 catalog illustrates and describes the manufacturer's expanded line of liquid eye indicators, showing sizes and styles now being offered. Allin Mfg. Co., 1153 W. Grand Ave., Chicago.

▸ *LOW WATER LINE BOILER*—Available from the manufacturer is a 4 page brochure which gives details for the firebox construction, low waterline boiler, "LWL" series. Portmar Boiler Co., 193 7th St., Brooklyn 15.

▸ *MOTOR CONTROLS*—A 46 page pocket catalog contains motor control photographs, specifications and prices. It is designed as a reference for magnetic starters and contactors, push buttons, combination starters, drum controllers, and switches. Furnas Electric Co., 1000 McKee St., Batavia, Ill.

▸ *PIPE CONNECTIONS, UNIONS, BLEEDER VALVES*—A new 12 page combination engineering manual and catalog describes the manufacturer's new "Graloc" line of pipe connections, unions and bleeder valves. Gray Tool Co., P.O. Box 2291, Houston 1.

▸ *PLASTIC PIPE, FITTINGS*—A 6 page folder contains data and specifications on the manufacturer's line of plastic pipe and fittings. Hints on installation for various uses are included. Crane Co., 836 S. Michigan Ave., Chicago 5.

▸ *POROUS STAINLESS STEEL FILTERS*—A range of stock filters available with porous stainless steel elements, prices and application data are contained in bulletin 213. Micro Metallic Corp., 30 Sea Cliff Ave., Glen Cove, N.Y.

▸ *PORTABLE SPACE HEATERS—Guide to the Selection and Use of Portable Space Heaters* covers the manufacturer's line of heaters designed for use in warehouses, construction jobs, workshops and spot heating. Herman Nelson Div., American Air Filter Co., Inc., Moline, Ill.

▸ *PUMPS*—The new No. 452 catalog illustrates and describes the manufacturer's "Graco Powerflo" pumps, circulating systems and equipment designed to spray or extrude liquids, semiliquids and semisolids used in production, construction and maintenance. Gray Co., Inc., 1023 Sibley St., Minneapolis 13.

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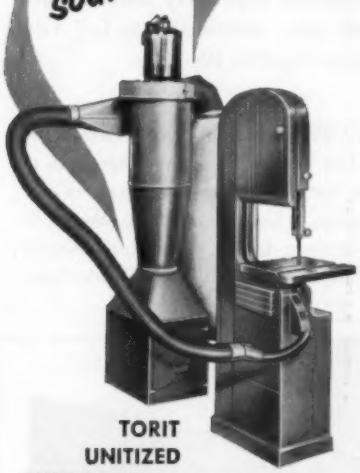
eliminates dust at its source!



TORIT UNITIZED DUST CONTROL means each machine has its own custom-tailored dust collector designed to work specifically for *that* machine. There is no guess work, or average suction. Furthermore, dust control is provided only when that machine is running . . . there is no waste of power such as you have with centralized control when only a few machines are operating. This means better dust control at lesser operating cost and less initial installation cost. Get the facts now on how Torit will work better to . . . "CLEAR THE AIR".

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CARVER PUMPS *are virtually* **MAINTENANCE-FREE** *because*

MECHANICAL SEAL permanently seals against shaft leakage. *No expensive time or material required to service these pumps.*

FRAME BEARINGS ARE GREASED FOR LIFE and *positively sealed against dirt and water.*

Trouble-free and maintenance-free, CARVER PUMPS are "*Your Best Buy for Better Performance.*"

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CARVER *The quality name in pumps*

200 amp.

A. C. Welding

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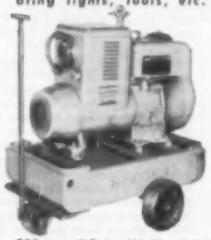
for tools, lights, etc.

AC Arc Welder and AC Power Unit for welding and operating lights, tools, etc.

To speed up the job and cut costs, plumbers and metalsmiths are using low cost Hobart Arc Welding wherever they can.

A popular model with the plumbing and heating contractors is the combination AC Arc Welder and AC Power Unit. This two purpose machine supplies 200 amperes for welding or 5 KW AC Power for operating tools and lights where electric power is not available.

No matter what your requirements are, Hobart has a welder that is right for your work. Compact, lightweight welders for easy loading in truck or trailer or AC Transformer type welders for shop work. Check and return the coupon today for complete details.



200-amp DC Arc Welder with air-cooled engine.

AC Transformer Type Welder for general shop use.

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RECENT TRADE LITERATURE

Continued

▸ *REFLECTIVE RADIANT CONDITIONING*—A 16 page bulletin contains information on the company's concept of reflective radiant conditioning for larger commercial structures as well as for residential use. Reflectotherm, Inc., 26 E. University Ave., Cincinnati.

▸ *REGISTERS AND GRILLES*—A new 2 color catalog illustrates and contains price lists for the company's line of registers and grilles for industrial and commercial applications. Stewart Mfg. Co., Cedar Grove, N.J.

▸ *RELIEF VALVES*—A new 20 page catalog No. 5200, describes and illustrates the company's "Multiport" relief valves. Cochrane Corp., 3131 N. 17th St., Philadelphia 32.

▸ *ROLL BONDED METALS*—The process for roll bonding metals with internal systems of tubing for heat exchangers is illustrated in the manufacturer's new literature. Olin Mathieson Chemical Corp., Western Roll Bond Metals Div., Alton, Ill.

▸ *ROTAMETERS*—Bulletin 115 gives information on the company's "Full-View" rotameters. Side plate construction and safety features, flow capacity charts, details of design and construction, dimensional drawings, tube and float materials and design data, various modifications of standard meters and full line of accessory equipment are also illustrated. Brooks Rotameter Co., Lansdale, Pa.

▸ *SEWAGE EJECTOR TABLES*—Engineering tables, designed to simplify the selection of the company's "Flush Kleen" sewage ejectors, include examples for determining the inflow, discharge heads and type of ejector to use for industrial applications and building installations. Chicago Pump Co., 622 Diversey Pkwy., Chicago 14.

▸ *SPRAY DEHUMIDIFIER*—Information on the company's new line of coil type spray dehumidifiers is contained in an 8 page bulletin. Marlo Coil Co., 6135 Manchester Ave., St. Louis 10.

▸ *TANK VENT FLAME ARRESTERS*—Details of the manufacturer's line of tank vent flame arresters is contained in a new catalog sheet. The arresters are designed for protection when mounted on the ends of vent pipes of storage tanks containing volatile liquids. Air-Maze Corp., 25000 Miles Rd., Cleveland.

. . . now air conditioned by

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the most practical air conditioning ever built!

Chicago's Drake Hotel Installs International Air Conditioning Well Below Average Cost!

Another of America's great hotels, The Drake in Chicago, has chosen International's Remote Type chilled and hot water units. This is in keeping with their policy of "Nothing but the finest" Ingenuity and skillful planning, by Refrigeration Systems, Inc. (the contractor), together with the compact design and low noise level of International's Ceiling Hideaway Units paid off with an economical installation that enabled them to have the finest equipment available, at less cost than average equipment. Each room boasts individually controlled units, yet no expensive duct-work was necessary. Due to International's sensible design, units were installed in closet ceilings utilizing otherwise wasted space and International's twin aluminum blowers keep noise level below that of the average fan (less than 25 decibels). Inquire NOW about how you can have the finest in hotel Air Conditioning . . . at less cost per room.

CEILING HIDEAWAY MODEL C. H. W. 90 is the model utilized by The Drake Hotel. Installation cost was far below average.

Console Hideaway Units also available in all standard sizes.

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NEW BRASS VALVES

FOR: FREON-OIL-WATER-STEAM

(300# working pressure)

SIZE: ⅛" MALE PIPE VALVE

5/16" S.A.E. FLARENUT

FLARE SEALS AVAILABLE

PRICE: $.45 each fob Philadelphia

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Get the same air delivery with only ⅓ the weight!

Model BD-43 is only 41⅜" high, delivers up to 16,500 cfm

New COOK all-aluminum belt-drive centrifugal ventilator

- Saves up to 400 lbs. on large models
- Only 6" high roof curb required
- Weatherproof aluminum shell and base
- Aluminum centrifugal wheel
- Compact belt-drive
- Low silhouette
- Non-overloading wheel, low tip speeds
- Rubber-mounted drive assembly
- From 1,000 to 16,500 cfm

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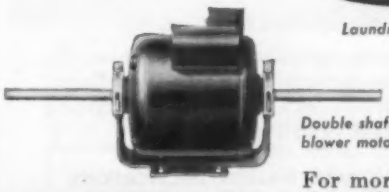

Double shaft blower motor

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INDUSTRIAL DIVISION OF
COLONIAL PLASTICS MFG. CO.

SUBSIDIARY OF THE VAN DORN IRON WORKS CO.
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RECENT TRADE LITERATURE *Continued*

▸ *THERMOSTAT*—An illustrated brochure gives performance specifications and a description of a new series "20000" liquid filled, local bulb thermostat. Fenwal, Inc., Ashland, Mass.

▸ *TUBING*—The manufacturer's 4 page folder gives decimal equivalents of various gages for tubing and equivalents of B.W. gages and fractions of an inch. Nikoh Tube Co., 5000 W. Whipple St., Chicago 32.

▸ *TUBING FOR RADIANT HEATING*—Bulletin No. 155 explains the installation and operation of finned tubing for radiant panel heating installations. Kritzer Radiant Coils, 2901 Lawrence Ave., Chicago 25.

▸ *UNIT HEATERS*—The manufacturer has issued a new 12 page bulletin on construction, application, selection and performance of its line of gas fired unit heaters. Modine Mfg. Co., Racine, Wis.

▸ *UTILITY FANS*—A 24 page bulletin describes the company's line of belt driven and direct drive centrifugal fans, their construction, and special features for specific types of applications. Trane Co., La Crosse, Wis.

▸ *VALVES*—A new reference manual, *The Fairbanks Valve Comparison Chart*, details the company's line of bronze and iron body valves compared with valves of other leading manufacturers. The Fairbanks Co., 393 Lafayette St., New York 3.

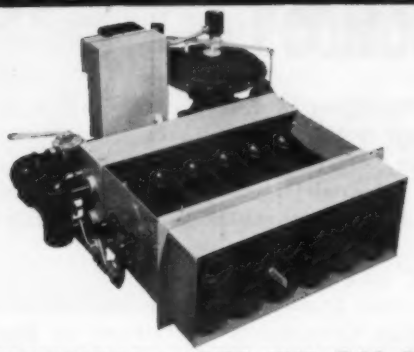
▸ *VALVES*—Forms 1001 and 1002 illustrate and give specifications for the company's lines of 200 lb bronze valves and valves for control of LP gas, respectively. Ohio Injector Co., Wadsworth, Ohio.

▸ *VERTICAL MOTORS*—A multicolor bulletin, illustrating the manufacturer's vertical solid shaft motors, includes "Unimount" vertical motors in ratings from ¼ to 400 hp in grease and oil lubricated types. U.S. Electrical Motors, Inc., Box 2058, Los Angeles 54.

▸ *WATER SAVERS*—An 8 page catalog describing a new line of water savers with all copper water surfaces covers "IEC" evaporative condensers and "CDT" cooling towers. Bush Mfg. Co., West Hartford, Conn.

▸ *WELDING SUPPLIES, ACCESSORIES*—The company is offering a new 36 page catalog, form ADC 848, covering its line of arc welding and oxyacetylene welding supplies and accessories. Air Reduction Sales Co., A Div. of Air Reduction Co., Inc., 60 E. 42nd St., New York 17.

for Gas Firing



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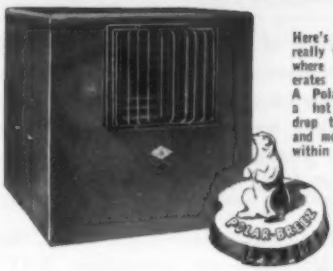

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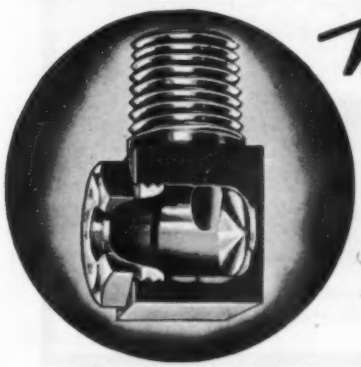

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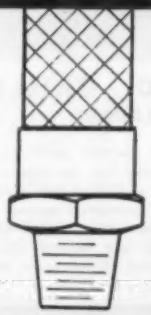

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I=W=H RATINGS of the Institute of Boiler and Radiator Manufacturers. Contains codes for indirect tankless water heaters tested with boilers and indirect storage and tankless water heaters, external types, tested in a tank. Institute of Boiler and Radiator Manufacturers, 608 Fifth Ave., New York 20.

85% MAGNESIA MANUAL—Revised Ed. 80 pp. Magnesia Insulation Manufacturers Association, 1317 F St., N.W., Washington 4. (State company and title.)

WATER SUPPLY AND PLANT EFFICIENCY—165 pp. Order PB 111454, Office of Technical Services, U.S. Department of Commerce, Washington 25. $3.00.

CONTROL OF EMISSIONS FROM METAL MELTING OPERATIONS—Compiled by AFS Air Pollution Control Committee. American Foundrymen's Society, Golf and Wolf Rds., Des Plaines, Ill. $2.25 ($1.50 to members).

A COMPARISON OF COAL-FIRED BROODING SYSTEMS—By D. W. Francis, K. C. Seeger, A. T. Ringrose and E. F. Waller. 16 pp. University of Delaware Agricultural Experiment Station, in cooperation with Bituminous Coal Research, Inc., 2609 First National Bank Bldg., Pittsburgh 22.

THE MAGNITUDE OF ERRORS IN STACK DUST SAMPLING and A METHOD FOR STACK DUST SAMPLING—By W. C. L. Hemeon and George F. Haines, Jr. 12 pp. Industrial Hygiene Foundation of America, Inc., Mellon Institute, 4400 5th Ave., Pittsburgh 13. Free.

TENTATIVE STANDARD METHOD FOR MEASURING ELECTRICAL CONDUCTANCE OF COATING ON BURIED PIPE LINES—Publication 55-1, National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2. 50c.

SYMPOSIUM ON ODOR—ASTM Special Technical Publication No. 164. 88 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3. $2.25.

CLIMATE AND ARCHITECTURE—By Jeffrey E. Aronin. 350 pp. Address the author, 389 Woodmore Blvd., Woodmere, Long Island, N.Y. $12.50.

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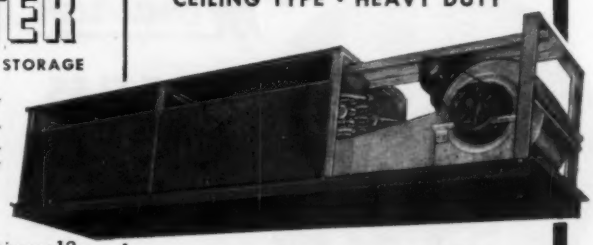

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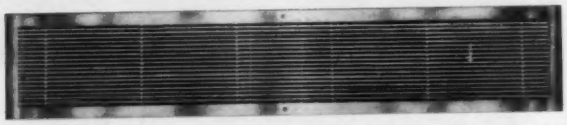

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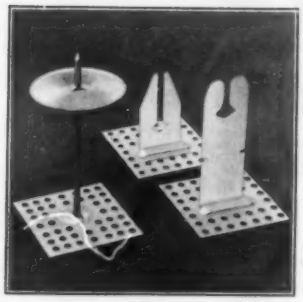

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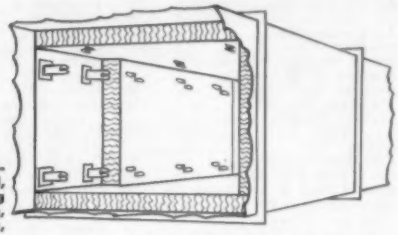

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SALES MANAGER for N. Y. Office, now employed, probably second in command, about 35, and in present position at least 5 years, selling fans, blowers, coils or related air conditioning and/or ventilating equipment. He knows and is known by architects, consulting engineers and engineers of large commercial and industrial firms in New York area. This is a most unusual opportunity. A good annual income is guaranteed with a territory profit-sharing arrangement. Please reply only if you can meet all the specifications. Address: J. Taylor, Connor Engineering Corp., Danbury, Conn.

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